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ARGONNE NATIONAL LABORATORY

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RESIDENTIAL FUEL CONSUMPTION PATTERNS FOR POOR, BLACK, AND ELDERLY HOUSEHOLDS: A COMPARATIVE STUDY

VOL. 1: DATA BASE DEVELOPMENT

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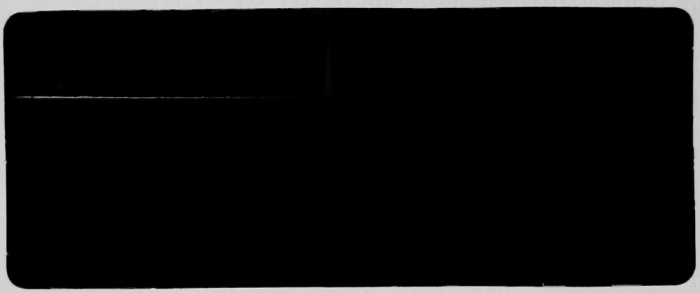

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RESIDENTIAL FUEL CONSUMPTION PATTERNS FOR POOR, BLACK, AND ELDERLY HOUSEHOLDS: A COMPARATIVE STUDY

VOL. 1: DATA BASE DEVELOPMENT

by

David Poyer and Arvind Teotia

Energy and Environmental Systems Division

December 1982

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RESIDENTIAL FUEL CONSUMPTION PATTERNS FOR POOR, BLACK, AND ELDERLY HOUSEHOLDS: A COMPARATIVE STUDY

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ABSTRACT

The United States Congress under Public Law 95-619, Part 3, Section 211, of 1978 established the Office of Minority Economic Impact (MI) within the U.S. Department of Energy. The director of MI is required, to the greatest extent practicable, to: (1) determine energy consumption and use patterns of minorities relative to other population categories; (2) evaluate the percentage of disposable income spent on energy by minorities relative to other population categories; and (3) determine how programs, policies, and actions of the Department impact minority energy consumption and use patterns and income. Under this statutory authority, MI is sponsoring the Minority Energy Consumption and Use Patterns Program at Argonne. This program has two objectives. The first is to develop, maintain, and update a comprehensive energy consumption data base that details energy consumption for minority population categories. The second is to develop an assessment model that will detail the comparative effects of federal policy on the patterns of energy consumption by minorities and their income. In this report, the first of two volumes, energy consumption data (for 1979) are presented for three target population categories -- Poor, Black, and Elderly -- and the nation as a whole. The data give information on energy consumption for the three population categories and the nation at different levels of detail.

EXECUTIVE SUMMARY

The purpose of this report is to present a profile of residential fuel consumption patterns for specific minority population categories. The effort in Volume 1 primarily involves the gathering and cross-tabulation of fuel consumption data, that is, the development of a minority energy-consumption data base. Future efforts will be centered on maintaining and updating the data base and on developing a minority energy-assessment model (MEAM). In

Volume 2, analysis that details the methodology underlying MEAM will be presented. Estimates of long- and short-run price and income elasticities will also be reported in Volume 2. It is our intention at Argonne to maintain a continuous capability to update and analyze, in support of the U.S. Department of Energy's Office of Minority Economic Impacts, the fuel consumption patterns of minorities and the impact of federal energy policy on these patterns.

In Volume 1, we have not determined cause/effect relationships, although on occasion clear inferences may be drawn from the data contained herein. Our primary concern is the computation of fuel consumption data at the household level for three target population groups, that is, Poor, Black, and Elderly. These data are in turn juxtaposed against information for a general or U.S. category, called National. This category represents the "typical" U.S. household and provides a point of reference.

Compared to that in the National category, fuel consumption (with the exception of the Black population category) is significantly lower for the target households (see Table 1). The reason for the abnormally high level of residential fuel consumption by Blacks is unclear. There is, however, some preliminary evidence indicating that the average age of housing in the Black community is the responsible factor. A relatively large portion of housing in Black communities was built before 1950, and these structures tend to be inadequately insulated. Furthermore, the spatial configurations of these dwellings, including such factors as high ceilings, lead to higher fuel consumption. Annual fuel consumption is 110, 138, and 121 x 10^6 Btu/household for Poor, Black, and Elderly households, respectively, compared to 127 x 10^6 Btu/household for the National category. The relative difference in fuel consumption varies dramatically across census regions. Fuel consumption by Blacks in the Northeast and North Central census regions is more than 20% and 30% higher, respectively, than the average level of consumption in these regions. The large variations in fuel consumption in these regions partially explain the overall difference that exist in fuel consumption between the Black and National categories. Moreover, it is not considered coincidental that, on the average, a larger portion of Black families in these regions live in older homes (approximately 80% and 75% of all Black households live in homes built before 1950, in the Northeast and North Central regions, respectively, compared to only 55% for the National category in each region).

Compared to that for the National category, fuel expenditure share of income is significantly greater for the three target population categories (see Table 1).* Therefore, it might be said that fuel consumption, as meas-

*The mean values were statistically tested against the mean value of the target population category's complement.

Table 1 Fuel Consumption and Share of Income per Household, 1979

	National Category		Target Population Categories					
			Poor Households		Black Households		Elderly Households	
Census Region	Fuel Consumption[a] (10^6 Btu/ Household)	% of Income[b]	Fuel Consumption (10^6 Btu/ Household	% of Income	Fuel Consumption (10^6 Btu/ Household	% of Income	Fuel Consumption (10^6 Btu/ Household	% of Income
Northeast	150	7.7	136[c]	19.1[c]	184[c]	13.4[c]	157	11.7[c]
North Central	166	6.3	145[c]	15.2[c]	217[c]	9.5[c]	157[c]	8.9[c]
South	95	6.3	83[c]	12.8[c]	102[c]	8.5[c]	86[c]	8.3[c]
West	100	3.9	83[c]	9.8[c]	85	3.8	86[c]	5.2[c]
U.S. Average	127	6.2	110[c]	14.3[c]	138[c]	8.9[c]	121[c]	8.6[c]

Source: U.S. Dept. of Energy (1981c).

[a]For all pairwise combinations the mean values for census regions for the National category are not significantly equal at 0.05 confidence level.

[b]For all pairwise combinations, with the exception of North Central and South regions, the mean values for census regions are not significantly equal at 0.05 confidence level.

[c]Values are significantly different than the mean value of their complementary set at 0.05 confidence level.

ured by its expenditure share of income, is relatively more important for these categories. The fuel expenditure share of income is 14.3%, 8.9%, and 8.6% for the Poor, Black, and Elderly household categories, respectively, compared to only 6.2% for the National category. The relative difference in fuel expenditure share varies across census regions. For example, in the Northeast, the gap between the target population categories and the National category is much wider. Here the fuel expenditure share is 19.1%, 13.4%, and 11.7% for Poor, Black, and Elderly households, respectively, whereas it is 7.7% for the National category.

Another significant finding of this study is that the following groups consume more fuel and spend a larger share of their income on fuel:

- Families living in older homes.
- Families living in colder climates.

Finally, it was found in this study that, because of variation in income and fuel price, the following groups typically consume less fuel but spend a larger share of their income on it:

- Families living in multifamily housing units.
- Families living in rural communities.

- Families living in rental units.

- Families living in homes heated with fuel oil/kerosene.

This report completes the first step in the Argonne Minority Energy Consumption and Use Patterns program. From here, more detailed analysis will be performed in the hope of fully characterizing the energy demand behavior of the target population groups.

1 INTRODUCTION

1.1 PURPOSE

The purpose of this volume is to provide a profile of fuel consumption by specific population categories. The report is a product of research being done for the Office of Minority Economic Impact (MI) in the U.S. Department of Energy (DOE). The overall purpose of the program is to develop a policy analysis model to be used by MI in evaluating the economic impact of federal energy policy on specific population categories.

A two-step approach is followed. In the first step (the subject of this volume), residential energy demand and its pattern of use are characterized for a base period. Second, a policy analysis model will be developed to evaluate alternative federal policy options and their effects on different population categories.

This report completes the first step by providing a profile of residential fuel consumption by the target population categories, that is, Poor, Black, and Elderly households.

1.2 APPROACH

We have three specific tasks at this stage in the program: to determine average levels of fuel consumption, pattern of fuel use, and expenditure share of income on fuel for each of the population categories. The year 1979 was chosen as the base year, primarily because of the availability of data. The fuel demand and expenditure data for the three target categories are compared to data for a reference category, called the National household category, in this year. Definitions of this and the three target population categories are given in the next subsection.

Most of the data referred to in this report are directly taken from, or are derived from, information in the 1979-80 Residential Energy Consumption Survey (RECS) Household Screener Survey (U.S. Dept. of Energy, 1981c). RECS is an annual survey of a statistically representative national sample of more than 4000 households and is conducted for the Office of Energy Markets and End Use in DOE's Energy Information Administration. The information in this data file is obtained through personal interviews with adult residents of the sample households and directly from the household's fuel supplier.

Factors that, in our view, influence residential fuel consumption are defined in Section 2. These factors are separated into economic, regional, housing, and demographic groups. Fuel consumption, fuel use patterns, and fuel expenditures are analyzed from an aggregate perspective in Section 3. In Section 4, fuel consumption is cross-referenced with the factors that influence residential energy consumption. Fuel consumption by the target population

categories is compared with the National category. Extreme care must be taken when drawing cause/effect conclusions from these sections. Finally, in Section 5, a brief summary is presented.

1.3 DEFINITION OF POPULATION CATEGORIES

1.3.1 National Category

The National category consists of all the households in the United States. The data used to characterize the pattern of fuel consumption by the National category are obtained from the RECS report; data were collected between April 1979 and March 1980 and include different demographic factors, along with consumption and expenditure data for natural gas, electricity, fuel oil and kerosene, and liquefied petroleum gas (LPG). These data are based on actual household bills for these fuels.*

1.3.2 Target Population Categories

The decision on criteria to use in defining other categories is constrained by the RECS data file. For example, there is no Hispanic category because the data in RECS are differentiated only by White, Black, and Other households. The following three subsections define the target population categories.

1.3.2.1 Poor Category

The definition of Poor is the same as that used in the RECS report and is based on family income for 1978 and number of family members in the household. This definition approximates the 125% level of poverty (see Table 2). Since income data are collected by ranges, the census poverty criteria cannot be used directly. Thus, the following rule was used to determine a Poor household for the RECS report: when the census poverty criteria (given in columns one and four of Table 2) are in the top half of the income range, they are used, but when the criteria fall in the bottom half of the income range, they are not used. For example, the $3000-$4999 income range is used to define a one-individual household as Poor, since the $4128 criterion is in the top half of the income range.

*Technically, electricity is not a primary fuel. It is, however, an important source of energy for residential energy consumers. Natural gas, fuel oil/kerosene, and LPG are considered primary sources of energy, whereas electricity is a secondary source.

Table 2 Definition of Poor Household ($)

Family Size	1978 Income Range	Census Level of Poverty	125% Poverty Level
1	<5,000	3,302	4,128
2	<5,000	4,225	5,281
3	<5,000	5,178	6,473
4	<8,000	6,628	8,285
5	<10,000	7,833	9,791
6	<12,000	8,825	11,031
7 or more	<15,000	10,926	13,658

Source: U.S. Dept. of Energy (1981a), p. 150.

1.3.2.2 Black Category

The Black category in this study is equivalent to that in the RECS data file. However, in using the RECS data, minority groups such as Hispanic, Asian, and American Indians cannot be defined in any greater detail. Thus, the Black category constitutes the extent to which analysis can be done for minorities.

1.3.2.3 Elderly Category

An Elderly household is defined as one in which the head of the household is at least 60 years old.

2 DEFINING FACTORS THAT INFLUENCE RESIDENTIAL FUEL CONSUMPTION

2.1 ECONOMIC FACTORS

2.1.1 Fuel Price

The determination of fuel price is quite simple. Both the aggregate fuel bill and the level of fuel consumption are given for a year that extends from April 1979 through March 1980. The average price level is calculated by taking the ratio of the fuel bill ($/household-year) to the level of fuel consumption (10^6 Btu/household-year).

In the RECS data file, fuel expenditures are expressed in terms of cents per year (¢/household-year), and fuel consumption is expressed in terms of 10^3 Btu per year (10^3 Btu/household-year). These data are transformed into terms of dollars per year ($/household-year) and 10^6 Btu per year (10^6 Btu/household-year). The ratio of these values gives the average price expressed in terms of dollars per 10^6 Btu ($/$10^6$ Btu). For example, assume the annual consumption of natural gas is 111 x 10^6 Btu/household and the annual fuel bill is $372/household; the calculated average unit cost of natural gas is therefore $3.35/$10^6$ Btu. This procedure is followed for each of the surveyed households.

2.1.2 Income

The income data are in the form of interval information that measures the total combined income for 1978 from all sources before taxes and deductions. It includes wages, salaries, tips, commissions, and income from social security, pensions, interest, dividends, rent, public assistance, and unemployment insurance. Included is the total income for all family members who lived in the household in 1978, regardless of whether they were living there at the time of the interview. Income of nonfamily members of the households is not included.

In the RECS household survey, respondents were asked to place their 1978 household income, as defined above, in one of 14 income intervals. Along with these intervals, 14-point estimates of income were made in order to further estimate the demand equations for fuel and the fuel expenditure shares. Since the income reported was for 1978, it was escalated to give an estimate of 1979 income. The escalation factor was derived from personal income data reported by Data Resources, Inc. (1982). All of this information is shown in Table 3.

Table 3 Estimates of Household Income, 1978-1979

Household Income Interval[a]	Estimated 1978 Household Income	Estimated 1979 Household Income[b]
Under $3,000	$3,000	$3,387
$3,000- 4,999	4,000	4,516
5,000- 7,999	6,500	7,338
8,000- 9,999	9,000	10,161
10,000-11,999	11,000	12,419
12,000-14,999	13,500	15,242
15,000-19,999	17,500	19,758
20,000-24,999	22,500	25,402
25,000-29,999	27,500	31,048
30,000-34,999	32,500	36,692
35,000-39,999	37,500	42,338
40,000-44,999	42,500	47,982
45,000-49,999	47,500	53,628
50,000 or more	50,000	56,450

[a]U.S. Dept. of Energy (1981c).

[b]Estimated 1978 income is escalated by a factor of 1.129, which is derived from personal income data reported in Data Resources, Inc. (1982).

2.2 REGIONAL, HOUSING, AND DEMOGRAPHIC FACTORS

The regional, housing, and demographic factors considered in this study are not all-inclusive; other factors certainly contribute to the level of fuel consumption. Initially however, the listed factors seemed most important and at this stage in the study we confine ourselves to them. The following factors were considered:

- Geographic Region.
- Age of Housing.
- Weather Zone.
- Type of Living Quarters.
- Type of Community.
- Type of Possessorship.
- Primary Heating Fuel.

2.2.1 Geographic Region

These regions correspond to the four major United States census regions. They are:

- Northeast.
- North Central.
- South.
- West.

Figure 1 shows the regional boundaries and the states included in each region.

2.2.2 Age of Housing

Age of residential structure is placed in three broad categories:

- Built before 1950.
- Built between 1950 and 1974.
- Built after 1974.

The intent here is to capture different historical eras as they relate to changing energy prices. It is expected that the thermal integrity of homes has improved with escalating fuel cost, thus influencing the amount of fuel required to condition a space, all other things being equal.

Fig. 1 Census Regions of the U.S.

2.2.3 Weather Zones

The data are categorized into three weather zones:

- Cold: cooling degree days less than 2000 and heating degree days greater than or equal to 5500.
- Mild: cooling degree days less than 2000 and heating degree days less than 5500.
- Hot: cooling degree days greater than 2000 and heating degree days less than 3999.

It is felt that households located in different climate zones will have different energy requirements. Furthermore, it is possible that the variation in weather will also affect the distribution of fuel use. For example, it is likely that in hot weather zones more electricity is consumed because of greater air conditioning demand, whereas less heating fuel is consumed.

2.2.4 Type of Living Quarters

There are three types of living quarters:

- Single-family detached.
- Multifamily of two or more units.
- Other: mobile home, single-family attached, etc.

The type of living quarter is likely to be closely correlated to the size of the residence, the type of heating and cooling system, and the overall thermal integrity of the home. For example, a family living in a multifamily building will probably have less space to condition, be bounded on one or more sides by other apartments, and make use of a central heating or cooling system. As a result, less energy may be required than for a single-family detached home.

2.2.5 Type of Community

The data are broken into urban and rural communities. Urban refers to communities of 2500 inhabitants or more; this definition is consistent with that used in the 1970 census. On the other hand, rural simply refers to nonurban areas and includes communities of less than 2500 inhabitants.

2.2.6. Type of Possessorship

There are two types of possessorship; a household may either own or rent its living quarters. In general, energy consumption in a rented home is felt to be higher, assuming all other factors are equal. This is because the renters may not pay utility bills directly and thus do not receive relevant market signals. Furthermore, there is no compelling incentive for renters to invest in energy conservation items, since the appreciation value is realized by the owners of the property. The converse, of course, is true for families that own their homes.

2.2.7 Primary Heating Fuel

Primary heating fuels are placed in five categories:

- Natural (piped) gas.
- Liquefied petroleum gas, or LPG (includes bottled gas).
- Fuel oil and kerosene.

- Electricity.
- Other: coal, wood, solar, coal, and none.

Heating, particularly in the cold climate zone, is often essential. The level of consumption of a fuel used as a primary fuel source for space heating is often much higher than energy consumption used for appliances, lighting, etc. This is particularly true in areas where there are a high number of heating degree days.

3 OVERVIEW OF RESIDENTIAL FUEL CONSUMPTION AND PATTERN OF USE

3.1 PATTERNS OF TOTAL RESIDENTIAL ENERGY CONSUMPTION

Residential fuel use constitutes a significant part of the total energy use in the country. For 1979, the total residential fuel consumption was estimated to be 9.74 quads (1 Quad = 10^{15} Btu) for all households in the United States as estimated by the U.S. Department of Energy.* This corresponds to 12.3% of the total U.S. fuel consumption of 79.0 Quads in 1979 (Data Resource, Inc., 1982).

3.1.1 National Category

The breakdown of residential fuel consumption in various regions for all U.S. households is shown in Table 4. For the National category, natural gas was the most heavily used heating fuel (5.31 Quads), followed by electricity (2.42 Quads), fuel oil/kerosene (1.71 Quads), and LPG (0.31 Quads). As shown in Figure 2, this pattern corresponds to a 54.5% share for natural gas, 24.8% share for electricity, 17.5% share for fuel oil/kerosene, and 3.2% for LPG.

Among all census regions, North Central accounted for the largest share of the residential fuel consumption. The regional energy consumption pattern for all fuels, in Quads, was 3.48 (35.6%) for North Central, 2.50 (25.7%) for Northeast, 2.30 (23.6%) for South, and 1.47 (15.1%) for West.

3.1.2 Target Population Categories

3.1.2.1 Poor Category

The total residential fuel consumption by Poor households was 1.39 Quads (14.3% of all household fuel consumption of 9.74 Quads) in 1979. The breakdown of consumption by fuel type and by region is provided in Table 4. Compared to the National category, Poor households used more natural gas (59.7% vs. 54.5% of total fuel demand) and less electricity (21.6% vs. 24.8%) and fuel oil/kerosene (15.1% vs. 17.5%), as shown in Figure 2. This pattern is expected, because natural gas is relatively cheap when compared to electricity or fuel oil/kerosene, as shown in Table 5.

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*U.S. Dept. of Energy (1981a). Data are for 12-month period of April 1979 through March 1980. Electricity is counted at the point of entry (not at the point of generation).

Table 4 Total Residential Energy Consumption, April 1979 through March 1980 (in Quads)

Category and Census Region	Fuel Oil/ Kerosene	Natural Gas	Electricity	LPG	All Fuels
National					
Northeast	1.03	1.05	0.39	0.03	2.50
North Central	0.31	2.48	0.59	0.10	3.48
South	0.28	0.91	0.97	0.14	2.30
West	0.09	0.88	0.47	0.04	1.47
Total	1.71	5.31	2.42	0.31	9.74
Poor					
Northeast	0.14	0.17	0.04	0.00	0.35
North Central	0.01	0.40	0.05	0.01	0.48
South	0.04	0.20	0.14	0.03	0.41
West	0.02	0.07	0.06	0.00	0.15
Total	0.21	0.83	0.30	0.05	1.39
Black					
Northeast	0.12	0.10	0.03	0.004	0.26
North Central	0.01	0.29	0.04	0.003	0.33
South	0.06	0.22	0.10	0. 02	0.40
West	--	0.07	0.02	--	0.09
Total	0.20	0.68	0.18	0. 03	1.08
Elderly					
Northeast	0.29	0.25	0.08	0.01	0.63
North Central	0.12	0.67	0.12	0.02	0.93
South	0.08	0.28	0.23	0.04	0.64
West	0.04	0.19	0.11	0.00	0.35
Total	0.53	1.39	0.54	0.08	2.54

Source: U.S. Dept. of Energy (1981a; 1981b).

The regional distribution of fuel use for poor households was different than for the National category (Figure 3). The South accounted for a higher share of fuel use for Poor households compared to the National category (29.5% vs. 23.6% of total fuel demand). In contrast, the regional share of Poor households' fuel demand was lower than National households in the Northeast (25.2% vs. 25.7%), North Central (34.5% vs. 35.6%), and West (10.8% vs. 15.1%).

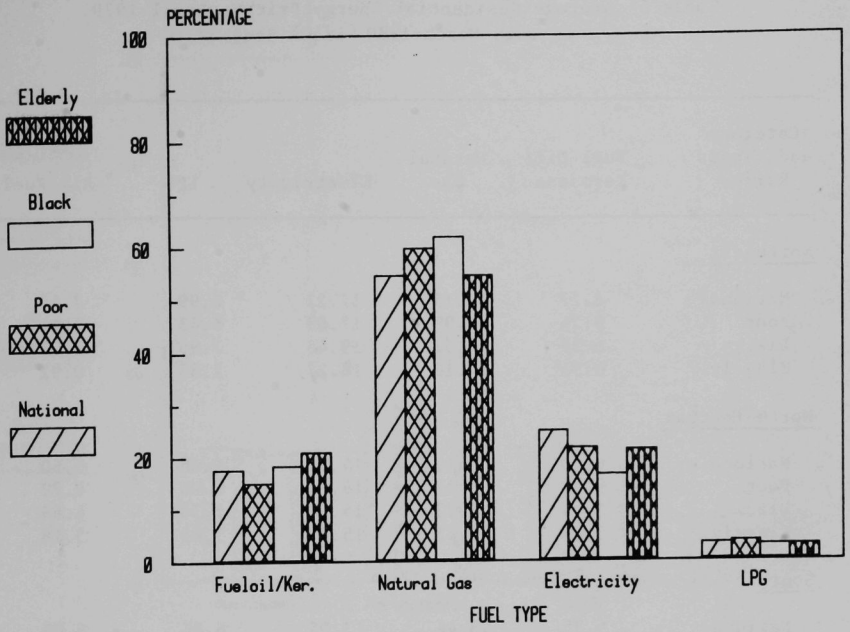

Fig. 2 Residential Energy Consumption by Type of Fuel for Different Population Categories, 1979 (Data from U.S. Dept. of Energy, 1981c)

3.1.2.2 Black Category

The total residential fuel consumption by Black households was 1.08 Quads in 1979, or 11.1% of the total residential fuel use of all households. The Black category's consumption by type of fuel in various census regions is given in Table 4. In comparison to the National category, Black households consumed relatively more natural gas (62.0% vs. 54.5%), and fuel oil/kerosene (18.5% vs. 17.5%), as shown in Figure 2. The share of electricity for Black households was lower than for the National category (16.7% vs. 24.8%). The pattern of use for LPG for the Black category was close to that of the National category (2.8% vs. 3.2%).

Figure 3 shows the regional shares of total residential fuel use by different population category. A marked difference is noted between the regional patterns of fuel use by the Black and National categories. The regional share of total fuel use by Black households was 24.1% for Northeast, 30.6% for North Central, 37.0% for South, and 8.3% for West. In contrast, the regional share for National category was 25.7% for Northeast, 35.6% for North Central, 23.6% for South, and 15.1% for West. The greater share of residential fuel use in the South for Black households is explained by the fact

Table 5 Average Residential Energy Prices, April 1979 through March 1980 ($/10^6 Btu)

Category and Census Region	Fuel Oil/ Kerosene	Natural Gas	Electricity	LPG	All Fuels
Northeast					
National	6.27	4.15	17.22	8.99	7.13
Poor	6.34	3.99	17.69	8.43	7.14
Black	6.37	4.52	19.45	7.95	7.03
Elderly	6.31	4.10	18.27	7.85	6.92
North Central					
National	6.30	3.15	14.82	6.08	5.50
Poor	6.29	3.12	16.66	6.06	4.79
Black	6.44	3.23	15.52	7.30	4.69
Elderly	6.32	3.15	15.84	5.83	5.26
South					
National	6.35	3.44	13.05	6.81	8.05
Poor	6.52	3.30	13.25	6.65	7.32
Black	6.26	3.34	14.49	7.52	6.83
Elderly	6.42	3.30	13.18	6.83	7.58
West					
National	6.25	2.93	9.40	6.15	5.26
Poor	6.38	3.17	7.63	7.42	5.33
Black	6.15	2.98	10.36	--	5.45
Elderly	6.31	3.18	8.90	6.42	5.44
United States					
National	6.29	3.36	13.46	6.71	6.49
Poor	6.39	3.35	13.34	6.73	6.09
Black	6.34	3.43	15.50	7.56	6.09
Elderly	6.33	3.36	13.60	6.65	6.27

Source: U.S. Dept. of Energy (1981a; 1981b).

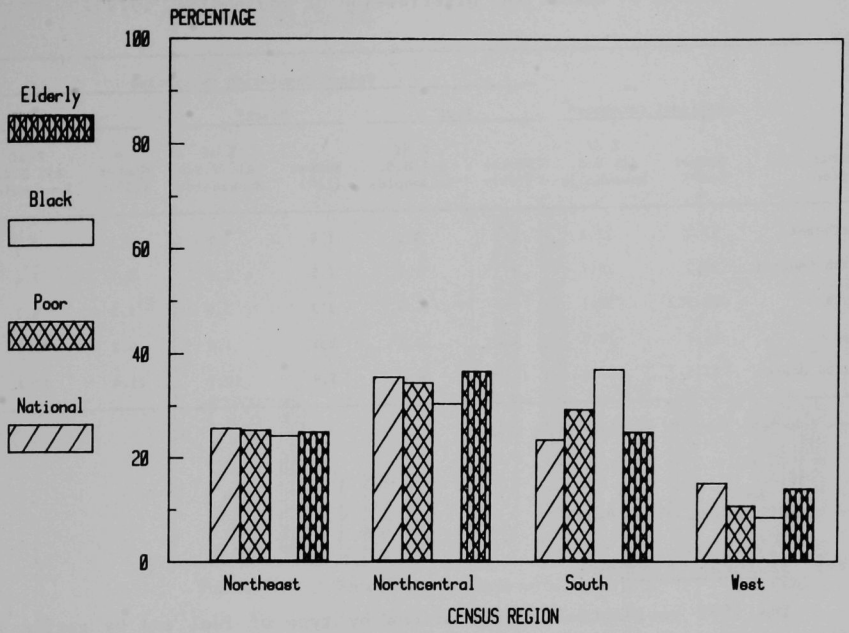

Fig. 3 Residential Energy Consumption by Region for Different Population Categories, 1979 (Data from U.S. Dept. of Energy, 1981c)

that approximately 50% of all Black households are located in the South region, compared to 32% of all National households (Table 6).

3.1.2.3 Elderly Category

The residential fuel use of Elderly households was 2.54 Quads in 1979, or 26.1% of the national residential fuel use in the same period. Consumption by type of fuel and by region are provided in Table 4. Fuel use by type of fuel for Elderly households was similar to that of the National category. The proportional share for Elderly and National households was 20.9% vs. 17.5% for fuel oil/kerosene, 54.7% vs. 54.5% for natural gas, 21.3% vs. 24.8% for electricity, and 3.1% vs. 3.2% for LPG (Figure 3).

The regional share breakdown for Elderly fuel consumption was also quite similar to that of the National category. The regional shares for Elderly and National households were 24.8% vs. 25.7% for Northeast, 36.6% vs. 35.6% for North Central, 24.8% vs. 23.8% for South, and 13.8% vs. 15.1% for West (Figure 3).

Table 6 Number and Distribution of Households, 1979

Census Region	National Category[a]		Target Population Categories					
			Poor		Black[a]		Elderly[a]	
	Number (10^6)	% of All U.S. Households	Number (10^6)	% of All U.S. Households	Number (10^6)	% of All U.S. Households	Number (10^6)	% of All U.S. Households
Northeast	17.2	22.2	2.7	3.5	1.4	1.8	4.1	5.3
North Central	20.7	26.7	3.3	4.3	1.5	1.9	5.7	7.4
South	24.9	32.1	5.0	6.5	3.9	5.0	7.5	9.7
West	14.7	19.0	1.8	2.3	1.1	1.4	4.1	5.3
United States	77.5	100.0	12.8	16.6	7.9	10.1	21.4	27.7

[a]Data from U.S. Dept. of Energy (1981a; 1981b).

3.2 RESIDENTIAL FUEL PRICES

3.2.1 National Category

The 1979 residential energy prices by type of fuel and by region for different population categories are provided in Table 5. There is wide variation among the prices of different fuels. For natural gas, fuel oil/kerosene, and LPG, the average cost to all households nationwide was \$3.36, \$6.29, and \$6.71 per 10^6 Btu, respectively. For electricity, the national average price was \$13.46/10^6 Btu. The weighted average price of all fuels to all households nationwide was \$6.49/10^6 Btu.

The regional price variation is very significant for natural gas and electricity. For the National category, natural gas prices were lowest in the West (\$2.93/10^6 Btu) and highest in the Northeast (\$4.15/10^6 Btu). Electricity prices were also lowest in the West (\$9.40/10^6 Btu) and highest in the Northeast (\$17.22/10^6 Btu). For fuel oil/kerosene, the regional variation was insignificant (\$6.25 to \$6.35/10^6 Btu). For LPG price variation was in the range of \$6.08/10^6 Btu (for North Central) to \$8.99/10^6 Btu (for Northeast).

3.2.2 Target Population Categories

For the Poor, Black, and Elderly, residential fuel prices are similar to those of the National category discussed in Section 3.2.1. A nationwide comparison of average residential fuel prices by type of fuel for different population categories is shown in Figure 4. A regional comparison of fuel price patterns for different population categories is also provided in Table 5.

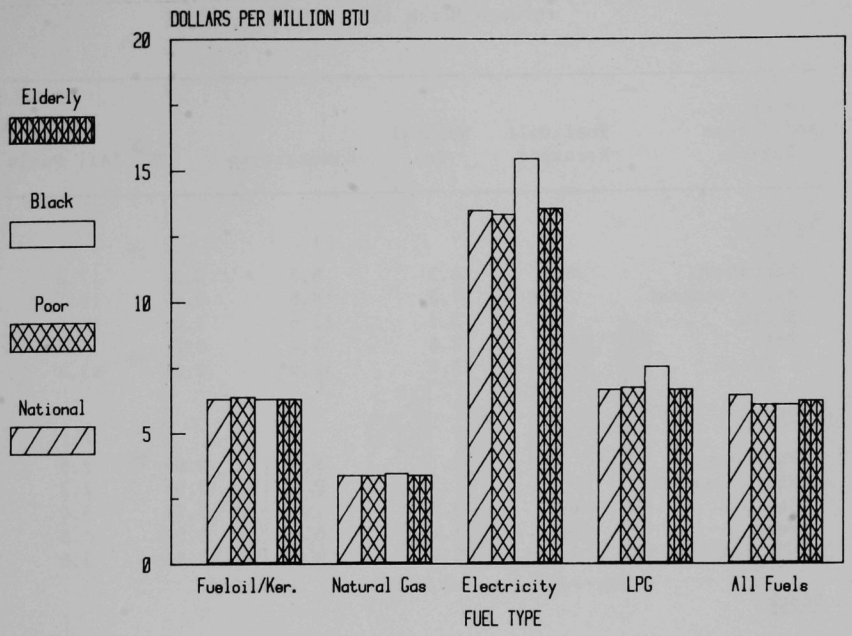

Fig. 4 Average Residential Energy Prices, 1979
(Data from U.S. Dept. of Energy, 1981c)

3.3 RESIDENTIAL FUEL EXPENDITURES

3.3.1 National Category

In 1979, a total of \$63.2 x 10^9 was spent by all U.S. households to purchase residential fuels. Expenditures by type of fuel in various regions are broken down in Table 7. Expenditure for electricity was \$32.6 x 10^9. This figure is very high because of the wide use of electricity by households and its high unit price. It was distantly followed by expenditures for natural gas (\$17.8 x 10^9), fuel oil/kerosene (\$10.7 x 10^9), and LPG (\$2.1 x 10^9). By type of fuel, these expenditures amount to 51.6% for electricity, 28.2% for natural gas, 16.9% for fuel oil/kerosene, and 3.3% for liquefied petroleum gas (Figure 5).

Regionwide, fuel expenditures were \$17.8 x 10^9 for Northeast, \$19.1 x 10^9 for North Central, \$18.5 x 10^9 for South, and \$7.7 x 10^9 for West. This corresponds to a share of 28.2%, 30.2%, 29.3%, and 12.3% of total fuel expenditures for Northeast, North Central, South, and West regions, respectively (Figure 6).

Table 7 Total Residential Fuel Expenditures, April 1979 through March 1980 (10^9)

Category and Census Region	Fuel Oil/ Kerosene	Natural Gas	Electricity	LPG	All Fuels
National					
Northeast	6.5	4.3	6.8	0.3	17.8
North Central	2.0	7.8	8.8	0.6	19.1
South	1.8	3.1	12.6	1.0	18.5
West	0.6	2.6	4.4	0.2	7.7
Total	10.7	17.8	32.6	2.1	63.2
Poor					
Northeast	0.9	0.7	0.8	0.04	2.5
North Central	0.1	1.3	0.9	0.08	2.3
South	0.3	0.7	1.8	0.23	3.0
West	0.1	0.2	0.5	0.01	0.8
Total	1.4	2.9	3.9	0.36	8.6
Black					
Northeast	0.8	0.5	0.5	0.03	1.8
North Central	0.1	0.9	0.6	0.02	1.6
South	0.4	0.7	1.5	0.13	2.7
West	--	0.2	0.3	--	0.5
Total	1.3	2.3	2.8	0.18	6.6
Elderly					
Northeast	1.8	1.0	1.4	0.07	4.3
North Central	0.8	2.1	1.9	0.13	4.9
South	0.5	0.9	3.1	0.31	4.8
West	0.3	0.6	1.0	0.02	1.9
Total	3.3	4.7	7.4	0.53	15.9

Source: U.S. Dept. of Energy (1981a; 1981b)

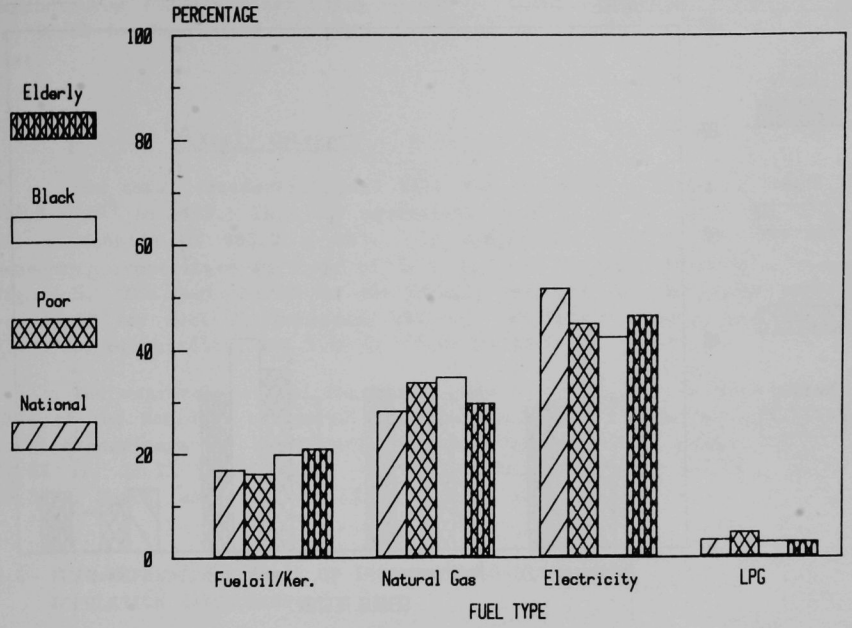

Fig. 5 Residential Energy Expenditures by Type of Fuel for Different Population Categories, 1979 (Data from U.S. Dept. of Energy, 1981c)

3.3.2 Target Population Categories

3.3.2.1 Poor Category

The total fuel expenditure for Poor households in United States in 1979 was $\$8.6 \times 10^9$, equivalent to 13.6% of National fuel expenditures ($\$63.2 \times 10^9$). Compared to that for the National category, the fuel expenditure share of electricity and fuel oil/kerosene for Poor households was smaller (45.3% vs. 51.6% and 16.3% vs. 16.9%, respectively). For the cheaper natural gas, however, usage was higher in Poor households than in National households (33.7% vs. 28.2%). Poor households spent 4.7% of their total fuel bill, compared to 3.3% for the National category, on LPG. Figure 5 compares residential fuel expenditure by type of fuel for the population categories.

For Poor households and the National category, the regional shares of total fuel expenditures were 29.1% vs. 28.2% for Northeast, 26.7% vs. 30.2% for North Central, 34.9% vs. 29.3% for South, and 9.3% vs. 12.3% for West.

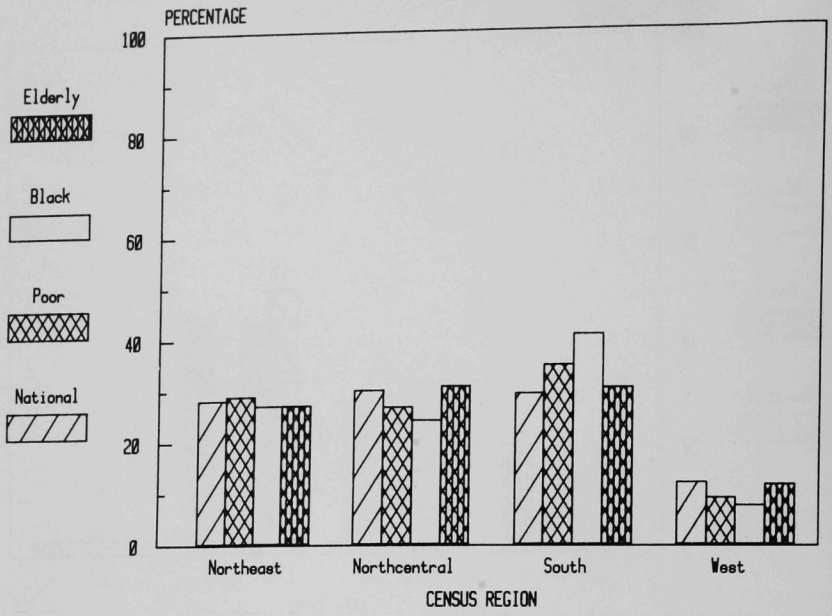

Fig. 6 Residential Energy Expenditures by Region for Different Population Categories, 1979 (Data from U.S. Dept. of Energy, 1981c)

Poor households have the highest regional share of fuel expenditures in the South, whereas in the National category the North Central region has the highest share.

3.3.2.2 Black Category

For the Black category, fuel expenditures in 1979 were estimated at $\$6.6 \times 10^9$. This is equivalent to 10.4% of total fuel expenditure of $\$63.2 \times 10^9$ for all households. The expenditure pattern by type of fuel for this category is compared to the National category in Figure 5. The fuel shares for Black and National categories were 42.4% vs. 51.6% for electricity, 34.8% vs. 28.2% for natural gas, 19.7% vs. 16.9% for fuel oil/kerosene, and 3.1% vs. 3.3% for LPG.

As for the Poor category, the regional share of total fuel expenditures for the Black category is highest in the South, as shown in Figure 6. Compared to that of the National category, the regional share of total fuel

expenditures for the Black category was 27.3% vs. 29.2% for Northeast, 24.2% vs. 30.2% for North Central, 40.9% vs 29.3% for South, and 7.6% vs. 12.3% for West.

3.3.2.3 Elderly Category

The total residential fuel bill for the Elderly category amounted to $\$15.9 \times 10^9$ in 1979. This was equivalent to 25.2% of the total fuel bill for all households of $\$63.2 \times 10^9$. In comparison to that of the National category, expenditure by type of fuel for the Elderly category is shown in Figure 5. The fuel shares for the Elderly and National categories were 20.8% vs. 16.9% for fuel oil/kerosene, 29% vs. 28.2% for natural gas, 46.5% vs. 51.6% for electricity, and 3.1% vs. 3.3% for LPG.

The regional pattern for Elderly fuel expenditures is very similar to that of the National category. As shown in Figure 6, the regional share of total expenditure for the Elderly and National categories was estimated to be 27.0% vs. 28.2% in Northeast, 30.8% vs. 30.2% in North Central, 30.3% vs. 29.3% in South, and 11.9% vs. 12.3% in West, respectively.

3.4 FUEL EXPENDITURE SHARE OF INCOME ACROSS DIFFERENT POPULATION CATEGORIES

The relative importance of fuel expenditures across different population categories is measured by estimating fuel expenditures as a percentage of the total income. As shown in Table 8, the 1979 total household income was estimated by multiplying the 1978 household income by the percentage increase in U.S. personal income from 1978 to 1979. Next, fuel expenditures as a percentage of total income were estimated for different population categories across Census regions. The disparity is very evident. Compared to a national average of 4.0%, total fuel expenditures as a percentage of income were estimated to be 13.2% for Poor, 5.9% for Black, and 5.3% for Elderly categories. This difference becomes even more noticeable across the regions. In the Northeast, for example, fuel expenditure as a percentage of income approaches 17.9% for Poor, 8.3% for Black, and 6.8% for Elderly, compared to 4.9% nationally.

Table 8 Total Household Fuel Bill as Percentage of Total Household Income

Census Region and Category	Total Income (10^9) 1978[a]	Total Income (10^9) 1979[a]	1979 Fuel Expenditure[b] (10^9)	1979 Fuel Bill as % of Total Income
Northeast				
National	320.8	362.2	17.8	4.9
Poor	12.4	14.0	2.5	17.9
Black	19.1	21.6	1.8	8.3
Elderly	56.2	63.4	4.3	6.8
North Central				
National	398.2	449.6	19.1	4.2
Poor	14.6	16.5	2.3	13.9
Black	22.6	25.5	1.6	6.3
Elderly	72.1	81.4	4.9	6.0
South				
National	405.2	457.5	18.5	4.0
Poor	22.7	25.6	3.0	11.7
Black	41.3	46.6	2.7	5.8
Elderly	83.0	93.7	4.8	5.1
West				
National	275.8	311.4	7.7	2.5
Poor	8.2	9.3	0.8	8.6
Black	15.9	18.0	0.5	2.8
Elderly	54.9	62.0	1.9	3.1
United States				
National	1400.0	1580.6	63.2	4.0
Poor	57.9	65.4	8.6	13.2
Black	98.9	111.7	6.6	5.9
Elderly	266.2	300.5	15.9	5.3

[a]1979 Household Income = 1978 Household Income x 1.129 (1979 U.S. Personal Income/1978 U.S. Personal Income). Source: Data Resources (1982).

[b]Data from U.S. Dept. of Energy (1981c).

4 RESIDENTIAL FUEL CONSUMPTION AND PATTERN OF USE: A HOUSEHOLD PERSPECTIVE

4.1 ECONOMIC INFLUENCES ON RESIDENTIAL FUEL CONSUMPTION: A COMPARATIVE STUDY

4.1.1 Price

In general, fuel consumption is expected to decrease with an increase in price, all other things remaining constant. Unfortunately, in the absence of a multivariant analysis, it is very difficult to discern the actual relationship between average price and fuel consumption when using cross-sectional data for a single period. The isolated effect of price on fuel consumption across the four population categories is obscured by changes in many other factors, some of which are covered in the next section.

In Table 9, average fuel consumption per household, average price, and income are shown for the four population categories. In general, there is very little difference in the average price by type of fuel across different categories. However, Black households pay on the average about $\$2/10^6$ Btu more than does the National category for electricity; i.e., $\$15.50/10^6$ Btu vs. $\$13.46/10^6$ Btu. This is probably attributed to distribution of the Black population; there are comparatively few Black families located in areas where electricity is relatively inexpensive, e.g., the West.

Scatter diagrams showing level of fuel consumption and price in the four population categories by fuel type are shown in Figure 7. The variation in average fuel consumption is not very well explained by price variations in isolation. However, it is our *a priori* hypothesis that price is still a very important variable in explaining variations in fuel consumption.

4.1.2 Income

In general, it is expected that fuel consumption increases with an increase in income, all other things remaining constant. However, on the surface, income does little better in explaining differences in fuel consumption across population categories than does price. This is particularly true when considering Black households. Although, on the average, Black households have incomes substantially lower than those of National households, the average level of annual fuel consumption is higher: 138×10^6 Btu/household vs. 127×10^6 Btu/household. Therefore, if our *a priori* hypothesis is correct, there must be other factors that influence fuel consumption independent of income.

Figure 8 shows scatter diagrams of the average level of fuel consumption and income across the four population categories by fuel type. No clear pattern is seen between fuel consumption and income. The effect of income (assumed positive) on fuel consumption can be more clearly demonstrated by multivariant analysis, which will be addressed in Volume 2.

Table 9 Fuel Consumption per Household; Average Fuel Price and Income for Actual Consuming Households, 1979

Fuel Type	National Category	Target Population Categories: Poor Households	Black Households	Elderly Households
Fuel Oil/Kerosene				
Consumption (10^6 Btu/ Household)	109	90	111	110
Average Price ($/$10^6$ Btu)	6.29	6.39	6.34	6.33
Household Income ($)	20,810	5,380	15,110	16,060
LPG				
Consumption (10^6 Btu/ Household)	45	37	30	36
Average Price ($/$10^6$ Btu)	6.71	6.73	7.56	6.65
Household Income ($)	17,980	5,140	10,160	10,920
Natural Gas				
Consumption (10^6 Btu/ Household)	109	100	111	104
Average Price ($/$10^6$ Btu)	3.36	3.35	3.43	3.36
Household Income ($)	20,270	5,130	14,470	14,060
Electricity				
Consumption (10^6 Btu/ Household)	32	23	24	26
Average Price ($/$10^6$ Btu)	13.46	13.34	15.50	13.60
Household Income ($)	20,400	5,090	14,120	14,040
All Fuels				
Consumption (10^6 Btu/ Household)	127	110	138	121
Average Price ($/$10^6$ Btu)	6.49	6.09	6.09	6.27
Household Income ($)	20,400	5,090	14,120	14,040

Source: U.S. Dept. of Energy (1981c).

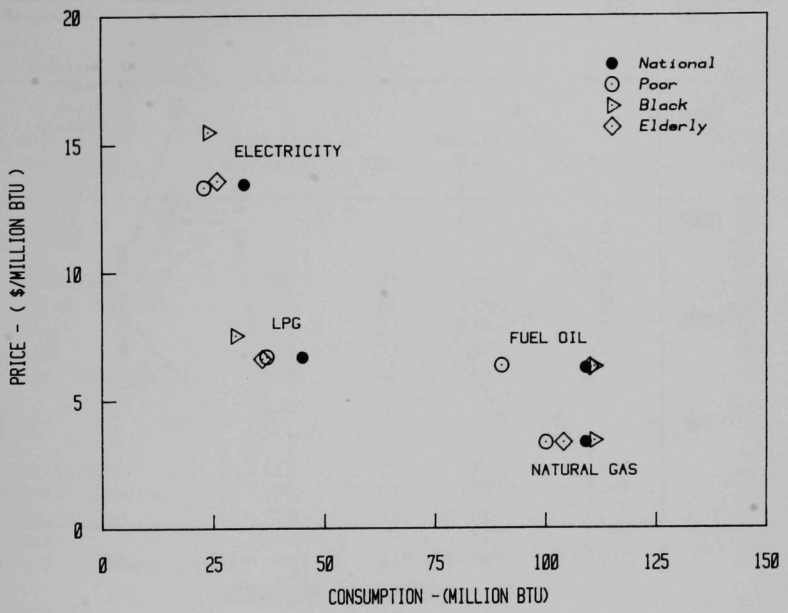

Fig. 7 Average Fuel Consumption vs. Price

4.2 REGIONAL, HOUSING STOCK, AND DEMOGRAPHIC INFLUENCES ON RESIDENTIAL FUEL CONSUMPTION: A COMPARATIVE STUDY

As stated in Section 2, seven factors and their influences on fuel consumption are being given specific attention. In this subsection, the relationship between these factors and energy consumption at the household level is examined.

Energy consumption is cross-referenced against these seven factors individually; these factors, however, are not all independent. For example, there is an overlap between weather zones and census regions. Therefore, in order to isolate the individual effects, a multivariate analysis will be done; results will be reported in Volume 2.

4.2.1 The Regional Factor

Average fuel consumption for actual consuming households varies widely, depending upon the type of fuel and census region being considered. Fuel consumption per household by census region, fuel type, and population category is summarized in Table 10. The average level of fuel consumption per household is greatest in the North Central region, where the average level

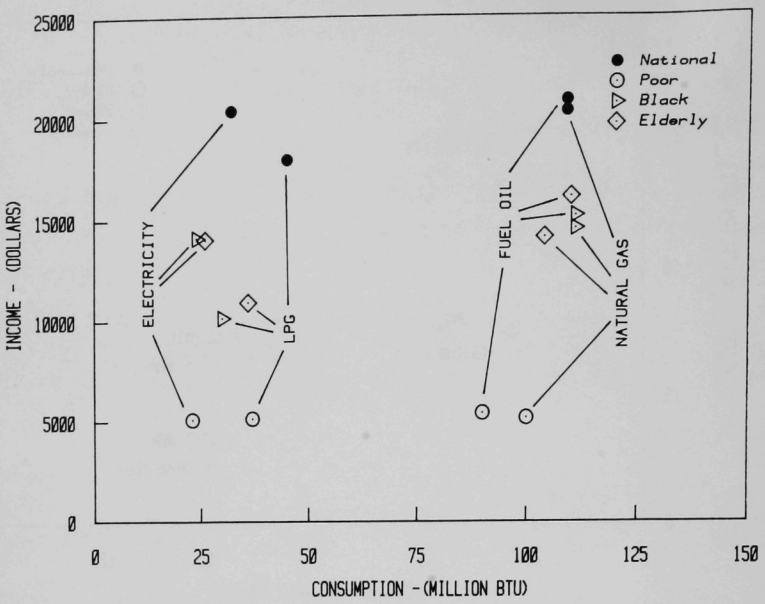

Fig. 8 Average Fuel Consumption vs. Income

level of fuel consumption for the four population categories is 166, 145, 217, and 157 x 10^6 Btu/household for the National, Poor, Black, and Elderly households, respectively. Figure 9 gives a graphic comparison of the average level of fuel consumption per household by census regions for the four population categories.

Also shown in Table 10 is the average level of fuel consumption per household by fuel type for actual consuming households. Average fuel consumption for actual consuming households varies widely depending on fuel type. As expected, primary fuels -- natural gas and fuel oil/kerosene -- are, on the average, consumed at a much higher level.* Figure 10 shows the average level of fuel consumption for the four population categories by fuel type. The average level of consumption of natural gas and fuel oil/kerosene, which are used primarily for space heating, is generally higher than that of the other

*Although LPG is also a primary fuel, its level of consumption is lower because it is used primarily in the rural South. Approximately 76% of the hosueholds that use LPG as a primary heating source are located in the South.

Table 10 Average Fuel Consumption for Actual Consuming Households, by Region for 1979 (10^6 Btu/Household)

Census Region and Category	Fuel Oil/ Kerosene	LPG	Natural Gas	Electricity	Weighted Average[a]
National					
Northeast	133	22	96	22	150
North Central	113	81	146	28	166
South	66	37	88	40	95
West	86	73	84	34	100
U.S. Average	109	45	109	32	127
Poor					
Northeast	119	24	89	16[b]	136[b]
North Central	86	65	135[b]	16[b]	145[b]
South	54	34	81	27[b]	83[b]
West	74	-	67[b]	35	83[b]
U.S. Average	90[b]	37[b]	100[b]	23[b]	110[b]
Black					
Northeast	151	28	88	19	184[b]
North Central	106	-	193[b]	24	217[b]
South	73	27[b]	88	28[b]	102[b]
West	-	-	69[b]	15[b]	85
U.S. Average	111	30[b]	111	24[b]	138[b]
Elderly					
Northeast	137	22	99	19[b]	157
North Central	119	67	140	20[b]	157[b]
South	64	32	84	32[b]	86[b]
West	88	-	68[b]	30[b]	86[b]
U.S. Average	110	36[b]	104[b]	26[b]	121[b]

Source: U.S. Dept. of Energy (1981c).

[a]For all pairwise combinations the mean values for census regions for the National category are not significantly equal at the 0.05 confidence level.

[b]Values are significantly different from the mean value of their complementary set at the 0.05 confidence level.

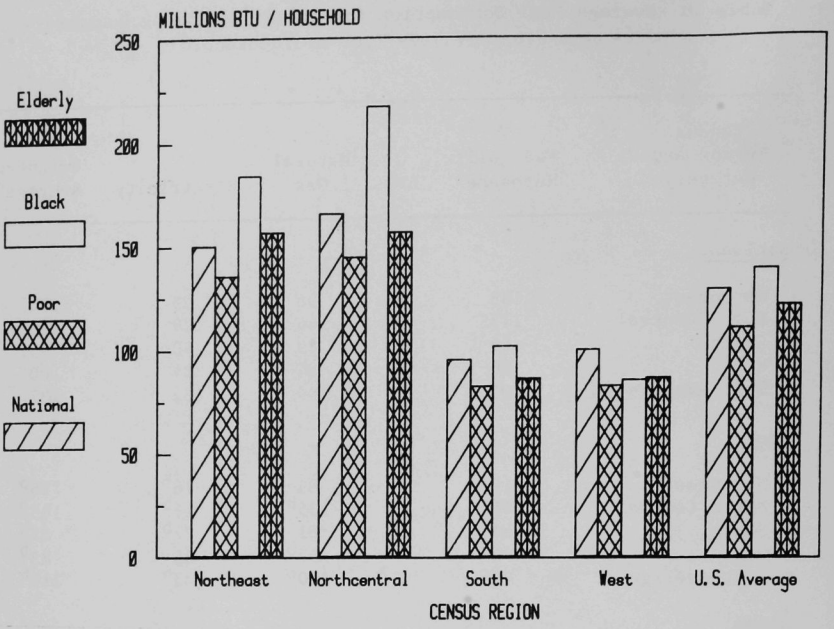

Fig. 9 Average Residential Fuel Demand per Household, by Region for 1979 (Data from U.S. Dept. of Energy, 1981c)

fuels. The average consumption of these fuels ranges from 90 x 10^6 Btu/household to 111 x 10^6 Btu/household, whereas the average consumption of electricity ranges from 24 x 10^6 Btu/household to 32 x 10^6 Btu/household.

In Tables 11 through 14, fuel consumption by region and population categories is shown. Table 11 shows the average household consumption level of fuel oil/kerosene. The highest level of consumption of fuel oil/kerosene for the four population categories occurs in the Northeast. Consumption is highest in Black households and lowest in Poor households. Fuel oil/kerosene consumption is approximately the same for National and Elderly households in the Northeast.

Consumption of fuel oil/kerosene in the other three census regions is substantially lower than in the Northeast at both the household and aggregate levels. In the Northeast, approximately 60%, 67%, 60%, and 55% of all fuel oil/kerosene consumed within each category is consumed by the National, Poor, Black, and Elderly household categories, respectively. A prominent value is the relatively high consumption of fuel oil/kerosene by Black and Elderly

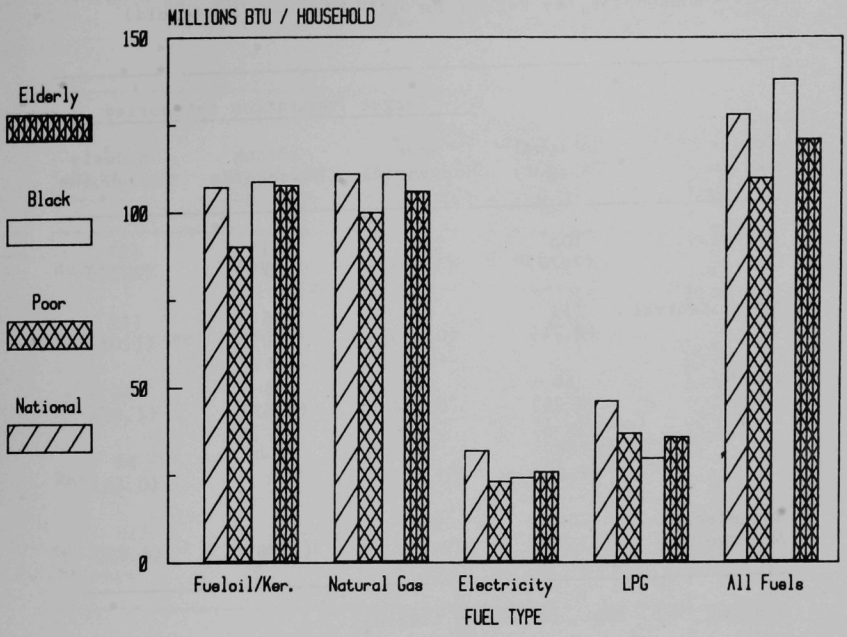

Fig. 10 Average Residential Fuel Demand per Household for Actual Consuming Households, by Fuel Type for 1979 (Data from U.S. Dept. of Energy, 1981c)

households in the Northeast. This is true even though household incomes for both are substantially lower than the National average.* However, in the Northeast a disproportionately large number of Black and Elderly families live in older homes. The percentage of homes built before 1950 for the National category in the Northeast is approximately 57%, whereas for the Black and Elderly categories it is 88% and 70%, respectively. Later in this report, the relationship between the age of a residential structure and fuel consumption will be discussed in greater detail. However, it seems the older the structure in which a family lives, the more fuel it requires.

*It might be argued that since disposable income is not being used, the income figure used might lead to erroneous conclusions. However, even if disposable income were used, it could not possibly explain the large difference in energy consumption.

Table 11 Fuel Oil/Kerosene Consumption by Actual Consuming Households, by Region for 1979 (10^6 Btu/Household)

Census Region	National Category	Target Population Categories		
		Poor Households	Black Households	Elderly Households
Northeast	133 (7.74)[a]	119 (1.18)	151 (0.79)	137 (2.12)
North Central	113 (2.74)	86 (0.12)	106 (0.09)	119 (1.01)
South	66 (4.24)	54 (0.74)	73 (0.82)	64 (1.25)
West	86 (1.04)	74 (0.27)	--[b]	88 (0.45)
Weighted Average	109 (15.76)	90 (2.31)	111 (1.70)	110 (4.83)

Source: U.S. Dept. of Energy (1981c).

[a]Figures in parentheses are approximate number of households (in millions) using fuel oil/kerosene. Regional values were derived using average household consumption data obtained from the RECS Household Screener Survey and aggregate consumption data from U.S. Dept. of Energy (1981a; 1981b). However, the Poor category was an exception. In this case, regional estimates of the number of households were made by extrapolating data in the RECS data file.

[b]Negligible value.

In the South census region, a substantial number of households use fuel oil/kerosene. Of all the households in each of the population categories that use fuel oil/kerosene, approximately 27%, 32%, 48%, and 26% are located in the South census region for the National, Poor, Black, and Elderly population categories, respectively. Because of climate, however, consumption is substantially lower.

On the other hand, the number of households using fuel oil/kerosene in the North Central and West census regions is small. Of the households in each population category that use fuel oil/kerosene, approximately 24%, 17%, 5%, and 30% are located in these regions for the National, Poor, Black, and Elderly population categories, respectively.

Table 12 LPG Consumption by Actual Consuming Households, by Region for 1979 (10^6 Btu/Household)

Census Region	National Category	Target Population Categories: Poor Households	Black Households	Elderly Households
Northeast	22 (1.36)[a]	24 (0.21)	28 (0.14)	22 (0.33)
North Central	81 (1.23)	65 (0.19)	--[b]	67 (0.33)
South	37 (3.78)	34 (1.02)	27 (0.74)	32 (1.40)
West	73 (0.55)	--[b]	--[b]	--[b]
Weighted Average	45 (6.92)	37 (1.42)	30 (0.88)	36 (2.06)

Source: U.S. Dept. of Energy (1981c).

[a]Figures in parentheses are approximate number of households (in millions) using LPG. Regional values were derived using average household consumption data obtained from the RECS Household Screener Survey and aggregate consumption data from U.S. Dept. of Energy (1981a; 1981b). However, the Poor category was an exception. In this case, regional estimates of the number of households were made by extrapolating data in the RECS data file.

[b]Negligible value.

Values for the level of consumption of liquefied petroleum gas (LPG) are given in Table 12. The most salient feature is the number of households that use this fuel; at the national level only about 9% of all households use LPG. The frequency of LPG use is greatest in the South census region. For all the households in each of the population categories that use LPG, approximately 55%, 72%, 84%, and 68% are located in the South for the National, Poor, Black, and Elderly households, respectively. Therefore, as should be obvious from these figures, Poor, Black, and Elderly households that use LPG are disproportionately high in the South.

Since the use of LPG is heavily concentrated in the South where it is commonly used for heating, the level of consumption per household is quite

Table 13 Natural Gas Consumption by Actual Consuming Households, by Region for 1979 (10^6 Btu/Household)

Census Region	National Category	Target Population Categories: Poor Households	Black Households	Elderly Households
Northeast	96 (10.9)[a]	89 (2.0)	88 (1.1)	99 (2.5)
North Central	146 (17.0)	135 (3.0)	193 (1.5)	140 (4.8)
South	88 (10.3)	81 (2.5)	88 (2.5)	84 (3.3)
West	84 (10.5)	67 (1.0)	69 (1.0)	68 (2.8)
Weighted Average	109 (48.7)	100 (8.5)	111 (6.1)	104 (13.4)

Source: U.S. Dept. of Energy (1981c).

[a]Figures in parentheses are approximate number of households (in millions) using natural gas. Regional values were derived using average household consumption data obtained from the RECS Household Screener Survey and aggregate consumption data from U.S. Dept. of Energy (1981a; 1981b). However, the Poor category was an exception. In this case regional estimates of the number of households were made by extrapolating data in the RECS data file.

low, ranging from 27 x 10^6 Btu/household for Black households to 37 x 10^6 Btu/household for National households.* In the North Central census region where the average consumption level per household is the highest, a significant number of households use LPG as a primary fuel source for space heating. Of the number of households shown using LPG in the North Central region, approxi-

*LPG is often used as a home heating fuel in poor rural communities where there is no access to piped gas and where fuel oil/kerosene and electricity for heating may be prohibitively expensive.

Table 14 Electricity Consumption by Actual Consuming Households, by Region for 1979 (10^6 Btu/Household)

Census Region	National Category	Target Population Categories		
		Poor Households	Black Households	Elderly Households
Northeast	22 (17.2)[a]	16 (2.7)	19 (1.4)	19 (4.1)
North Central	28 (20.7)	16 (3.3)	24 (1.5)	20 (5.7)
South	40 (24.9)	27 (5.0)	28 (3.9)	32 (7.5)
West	34 (14.7)	35 (1.8)	15 (1.1)	30 (4.1)
Weighted Average	32 (77.5)	23 (12.8)	24 (7.9)	26 (21.4)

Source: U.S. Dept. of Energy (1981c).

[a]Figures in parentheses are approximate number of households (in millions) using electricity. Every household surveyed in the RECS study uses electricity.

mately 60%, 68%, and 65% use LPG for space heating purposes for the National, Poor, and Elderly household categories, respectively.*

Natural gas is the most widely used primary fuel in the United States. It is used in approximately 50 million households, or about 64% of all households in the U.S. It is an extremely important source of energy for the three target population categories. In Poor, Black, and Elderly households, approximately 66%, 77%, and 63%, respectively, use natural gas in some way.

Natural gas is the primary fuel for space heating in 55%, 58%, 65%, and 55% of all the households within the National, Poor, Black, and Elderly

*The number of Black households using LPG in the North Central region is insignificant.

categories, respectively. Moreover, it is used primarily in regions with a high number of heating degree days, as is fuel oil/kerosene.

Table 13 indicates the concentration of natural gas use in the colder regions, particularly North Central. For the four population categories, approximately 35%, 35%, 25%, and 36% of all households that consume natural gas are located in the North Central region. Coupled with the fact that there are a significant number of households in the North Central region using natural gas, the level of its consumption is extremely high at the household level. For the four population categories in this region, the average level of consumption in 1979 was 146, 135, 193, and 140 x 10^6 Btu/household for the National, Poor, Black, and Elderly categories, respectively. Of these four values, the exceedingly high consumption for Black households stands out. Close analysis of the data indicates that this is related primarily to the age of the housing stock located in Black communities. In general, the housing stock in Black communities is very old; since the thermal integrity of older structures is usually lower, the average level of fuel consumption in Black communities is raised.*

In the North Central region, the average level of consumption of natural gas per household is quite high because a high percentage of households use it as the primary fuel for space heating. For all four population categories, more than 95% of all households that use natural gas in the North Central region also use it as the primary fuel for space heating. In the Northeast region, on the other hand, only about 70%, 60%, 50%, and 80% of all the households that use natural gas within the National, Poor, Black and Elderly households, respectively, use it as the primary fuel for space heating. (This explains the lower average consumption at the household level in the Northeast region when compared to that for the North Central region.)

When the average level of natural gas consumption at the household level is compared to that of the other primary fuel, i.e., fuel oil/kerosene, the values are rather close. However, natural gas consumption by Poor households is appreciably higher, that is, 100 x 10^6 Btu/household for natural gas vs. 90 x 10^6 Btu/household for fuel oil/kerosene. It is surmised that this is due to the price difference and the relative sensitivity of low-income households to price variation.

Table 14 gives the average level of electricity consumption per household and its incidence of use for the four population categories. Practically every household in the U.S. uses electricity. As is expected, the level of consumption per household is highest in the South census region. This is true for all the population categories with the exception of the Poor households.

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*More will be said about this in Section 4.2.2.

In the South census region, approximately 40, 27, 28, and 32 x 10^6 Btu/household of electricity is consumed by the National, Poor, Black, and Elderly households, respectively.

In the case of Poor households, the average level of electricity consumption is higher in the West census region -- 35 x 10^6 Btu/household versus 27 x 10^6 Btu/household in the South. This is probably due to the combination of the low unit price of electricity in the West and the high sensitivity of electricity demand to price changes in low income households.*

The average level of electricity consumption per household is higher for the National category than for the three target categories. Electricity's income elasticity is probably quite high; for this reason, electricity can be considered more of a luxury commodity. Intuitively, this is reasonable since the consumption of many luxury items is complemented with a higher level of electricity consumption. For example many home appliances require the use of electricity. On the average, approximately 32, 23, 24, and 26 x 10^6 Btu/household of electricity is consumed by the National, Poor, Black, and Elderly household categories, respectively.

Compared to fuel expenditures, level of fuel consumption is probably no more than a curiosity, from the household's point of view. The level of expenditures and its share of income is certainly of greater interest to the individual household. In Table 15, combined income per household for the four population categories is given by census region. Income for the National category is the highest in all four regions, whereas it is the lowest for Poor households. Income for the Black and Elderly households is roughly the same at both the regional and U.S. levels. At the U.S. level, the average household income for the National category is about 4 times that of the Poor category and about 1.4 times that of the Black and Elderly categories.

The average level of household expenditures for fuel and their share of income, by census region, for the four population categories is shown in Table 16. Both fuel expenditures and their share of income is the highest in the Northeast for all four population categories. Both harsh weather and the widespread use of expensive fuel oil/kerosene are partially responsible for this. In the Northeast, average fuel expenditures per household range from approximately $900 for Poor households to $1270 for Black households. Share of income ranges from approximately 8% for National households to 19% for Poor households. At the other extreme, average fuel expenditures and its share of income are lowest in the West census region. Here, average household fuel

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*The average price of electricity in the West census region in 1979 was approximately $8.00/$10^6$ Btu, whereas it was approximately $14.00/$10^6$ Btu in the South census region.

Table 15 Average Income per Household, 1979 ($)

Census Region	National Category	Target Population Categories: Poor Households	Black Households	Elderly Households
Northeast	20,960	5,120	15,090	15,220
North Central	21,720	4,980	16,980	14,290
South	18,373	5,120	11,960	12,500
West	21,180	5,170	16,320	15,110
U.S. Average	20,400	5,090	14,120	14,040

Source: U.S. Dept. of Energy (1981c).

Table 16 Fuel Expenditure and Share of Income per Household, by Region for 1979

Census Region	National Category		Target Population Categories: Poor Households		Black Households		Elderly Households	
	Fuel Expenditure ($)[a]	% of Income[b]	Fuel Expenditure ($)	% of Income	Fuel Expenditure ($)	% of Income	Fuel Expenditure ($)	% of Income
Northeast	1051	7.7	903[c]	19.1[c]	1275[c]	13.4[c]	1056	11.7[c]
North Central	899	6.3	698[c]	15.2[c]	1014[c]	9.5[c]	812[c]	8.9[c]
South	767	6.3	599[c]	12.8[c]	725	8.5[c]	657[c]	8.3[c]
West	541	3.9	453[c]	9.8[c]	451[c]	3.8	482[c]	5.2[c]
U.S. Average	828	6.2	666[c]	14.3[c]	844	8.9[c]	753[c]	8.6[c]

Source: U.S. Dept. of Energy (1981c).

[a]For all pairwise combinations, the mean values for census region are significantly different at 0.05 confidence level.

[b]For all pairwise combinations, with the exception of the North Central and South regions, the mean values for census regions are not significantly equal at the 0.05 confidence level.

[c]Values are significantly different from the mean value of their complementary set within that census region at the 0.05 confidence level.

expenditures range from approximately $450 for Black to $540 for National households. Share of income in the West ranges from approximately 4% for National and Black households to 10% for Poor households.

In Figures 11 through 13, fuel expenditures and their share of income by fuel type and census region are graphically shown. For households that consume fuel oil/kerosene, the average level of expenditure is the highest. The average level of household expenditure by consuming households ranges from approximately $580 for Poor households to $690 for Black households.

In general, level of fuel expenditure is correlated with household income. This is especially true in the case of electricity. National households spend approximately $430 on electricity, whereas only $310, $370, and $350 is spent on electricity by Poor, Black, and Elderly households, respectively.

Figures 12 and 13 show fuel expenditure and its share of income by census region. The magnitude of variation across census regions by population category is clearly shown. For all four population categories, both fuel expenditures and their share of income is highest in the Northeast.

4.2.2 Age of Housing

As mentioned earlier, the age of a community's housing has a direct bearing on the level of energy consumption. This is because older homes and buildings tend to be less energy efficient. Therefore, the age distribution of housing directly affects the average level of energy consumption. This fact is dramatically illustrated in Table 17 and Figure 14. For all four population categories, the average level of consumption per household increases with the age of the housing.*

In Table 18, the distribution of households over the three age classes of housing is shown. Proportionately more families in Poor, Black, and Elderly households live in housing built before 1950. Of all the households in the Poor, Black, and Elderly categories, 57%, 58%, and 55%, respectively, live in housing units built before 1950, whereas only 42% of the National households live in housing units built before that year.

In Table 19 and Figures 15 and 16, average fuel expenditures and their share of income are shown for the four population categories. Both the expenditures for fuel and their share of income rise as the age of the housing

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*Differences in these values reflect the influence of other factors on fuel consumption. As mentioned earlier, multivariate analysis is required in order to separate the isolated influences of these factors.

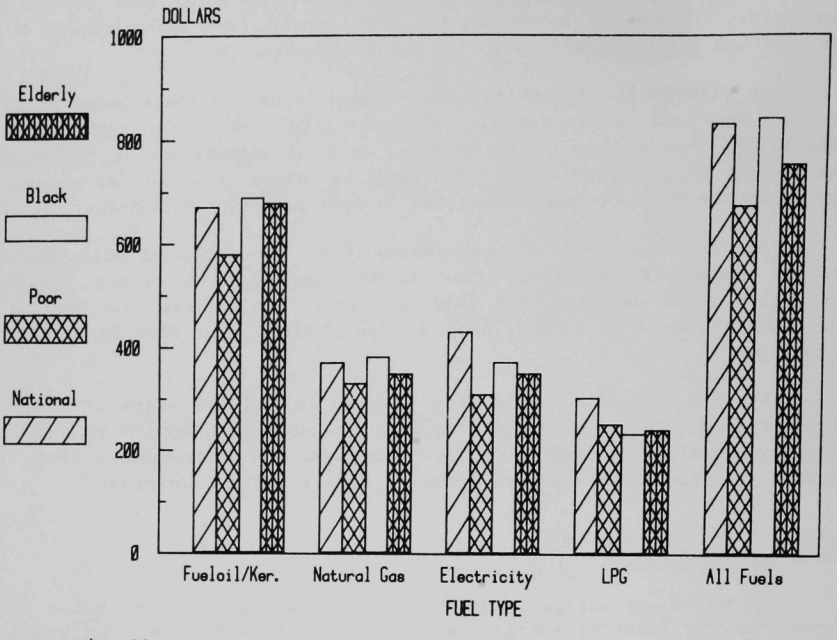

Fig. 11 Average Residential Fuel Expenditures per Household for Actual Consuming Households, by Fuel Type for 1979 (Data from U.S. Dept. of Energy, 1981c)

increases. This is true for all four population categories. Within each of the three classes of housing, Poor households expend the highest percentage of their income on fuel. The relative levels of expenditure for Black and Elderly households are about equal.

4.2.3 Weather Zone

In Table 20 and Figure 17, households are divided into three broad weather zone classifications, and average household levels of fuel consumption by weather zone class and population category are shown. The three weather zone classifications are referred to as Cold, Mild, and Hot and are shown in Figure 18. For all four population categories, the average level of fuel consumption declines across these three categories. The average level of consumption per household in the Cold weather zone ranges from about 140 x 10^6 Btu for Poor households to 230 x 10^6 Btu for Black households, whereas in the Hot zone, consumption ranges from approximately 80 x 10^6 Btu for Poor and Elderly households to 90 x 10^6 Btu for National and Black households.

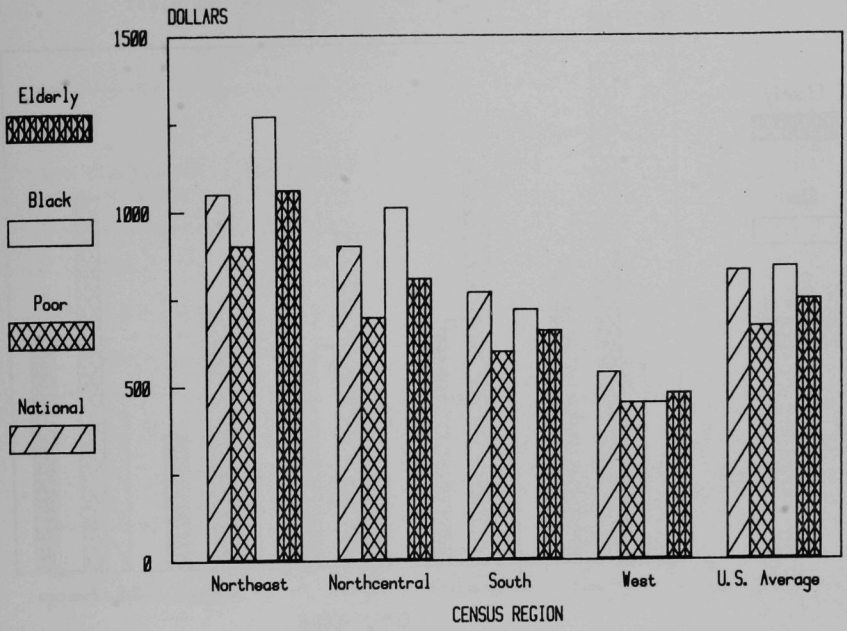

Fig. 12 Average Residential Fuel Expenditures per Household, by Region for 1979 (Data from U.S. Dept. of Energy, 1981c)

In Table 21, the distribution of households over the three weather zones is shown. Just over one-half of all families live in the Mild zone. Of all the households in the National, Poor, Black, and Elderly categories, approximately 51%, 51%, 53%, and 52%, respectively, are located in the Mild zone. The distribution across all zones is about the same for all the population categories, with the exception of the Black category, which has a relatively larger share in the Hot zone.

In Tables 22 and Figures 19 and 20, average level of fuel expenditures and share of income are shown for the four population categories. The level of expenditures for fuel increases with the number of heating degree-days for all four population categories. Within each of the three weather zones, Poor households pay out a greater percentage of their income for fuel. Black and Elderly households spend about the same share of their income on fuel in the Mild and Hot zones. However, the fuel expenditures and their share of income for Black households in the Cold zone are much higher.

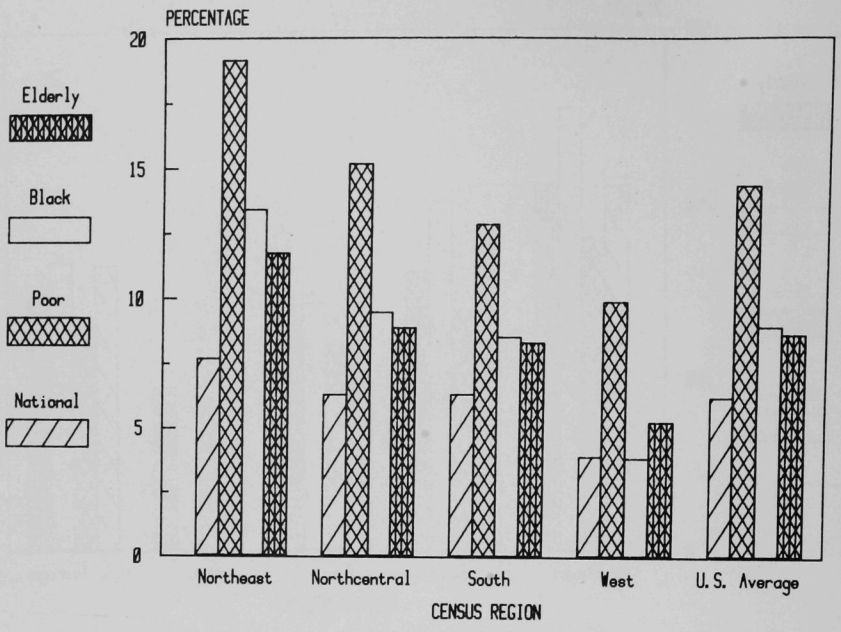

Fig. 13 Fuel Expenditure Share of Household Income, by Region for 1979 (Data from U.S. Dept. of Energy, 1981c)

4.2.4 Living Quarter Type

There are three types of living quarters: single-family detached, multifamily of two or more units, and single-family attached and other. The average level of fuel consumption per household by these types is shown in Table 23 and Figure 21. It is highest for families in the single family detached homes. Average fuel consumption ranges from approximately 120 x 10^6 Btu/household for Poor households to 140 x 10^6 Btu/household for National and Black households. The average level of fuel consumption per household in the other two types, within each population category, is rather close for all household categories, with the exception of Poor households. In this case, the average level of consumption between the multifamily and single family attached drops from approximately 100 x 10^6 Btu/household to 90 x 10^6 Btu/household.

The distribution of households over the three types is shown in Table 24. The distribution of National and Elderly households is quite similar, whereas the distribution of Poor and Black households is similar. In all

Table 17 Average Fuel Consumption, by Age of Housing Stock for 1979 (10^6 Btu/Household)

Age Classes of Housing Stock	National Category[a]	Target Population Categories		
		Poor Households	Black Households	Elderly Households
$X < 1950$	144	126[b]	155[b]	136[b]
$1950 \leq X < 1974$	120	91[b]	116	105[b]
$X \geq 1974$	102	71[b]	69	69[b]

Source: U.S. Dept. of Energy (1981c).

[a]For all pairwise combinations, the mean values for the different classes of housing stock are significantly different at 0.05 confidence level.

[b]Values are significantly different from the mean value of their complementary set within that class at the 0.05 confidence level.

cases, most families live in single-family detached dwellings, while the smallest number of families live in the single-family attached structures.*

Fuel expenditures and their share of income by type of living quarter are given in Table 25 and Figures 22 and 23. These values indicate a strong correlation between a family's type of living quarter and income. In general, fuel expenditures are higher for the single-family detached dwelling than for the other two types of living quarter. However, the expenditure share of income increases in all cases, with the exception of Poor households,** thus implying that income is falling.

4.2.5 Community Type

Communities are classified as either urban or rural. Table 26 and Figure 24 show the average level of fuel consumption per household for the

*Mobile homes are also included in the single-family attached type.

**This makes sense intuitively since the Poor category is defined using a rather stringent income criteria.

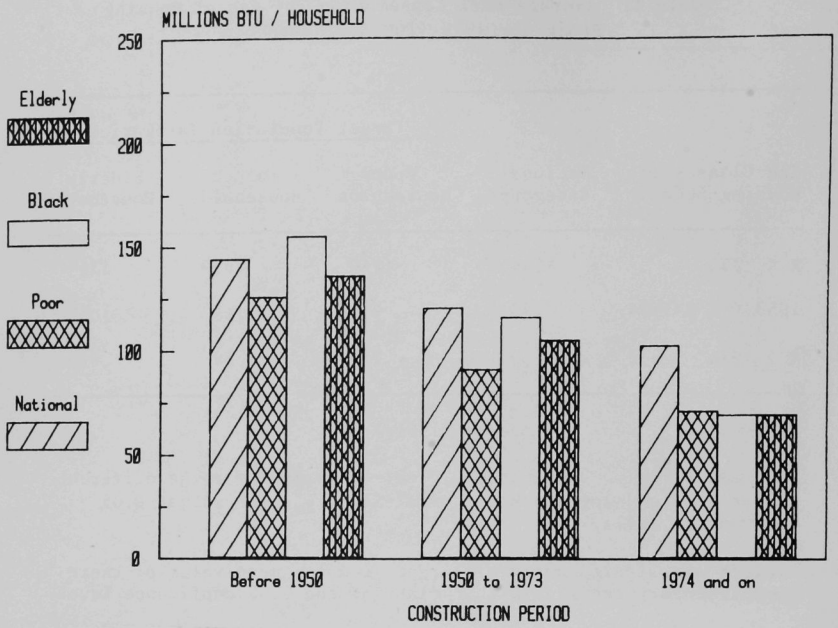

Fig. 14 Fuel Consumption per Household, by Age of Housing Stock for 1979 (Data from U.S. Dept. of Energy, 1981c)

Table 18 Distribution of Households, by Age of Housing for 1979 (%)

Age Classes of Housing Stock	National Households	Target Population Categories		
		Poor Households	Black Households	Elderly Households
$X < 1950$	42	57	58	55
$1950 \leq X < 1974$	50	39	40	42
$X \geq 1974$	8	4	2	3

Source: U.S. Dept. of Energy (1981c).

Table 19 Fuel Expenditure and Share of Income, by Age of Housing for 1979

Age Classes of Housing Stock	National Category		Target Population Categories: Poor Households		Black Households		Elderly Households	
	Fuel Expenditure ($)[a]	% of Income[b]	Fuel Expenditure ($)	% of Income	Fuel Expenditure ($)	% of Income	Fuel Expenditure ($)	% of Income
X < 1950	863	7.8	714[c]	15.6[c]	899	10.1[c]	804[c]	10.1[c]
1950 ≤ X < 1974	808	5.2	610[c]	12.8[c]	774	7.4[c]	700[c]	7.0[c]
X ≥ 1974	776	3.9	511[c]	10.2[c]	637	5.8	560[c]	5.4[c]

Source: U.S. Dept. of Energy (1981c).

[a]For all pairwise combinations, with the exception of 1950 ≤ X < 1974 and X ≥ 1974, the mean values for the different classes of housing stock are significantly different at the 0.05 confidence level.

[b]For all pairwise combinations, the mean values for the different classes of housing stock are significantly different at the 0.05 confidence level.

[c]Values are signficantly different from the mean value of their complementary set within that class at the 0.05 confidence level.

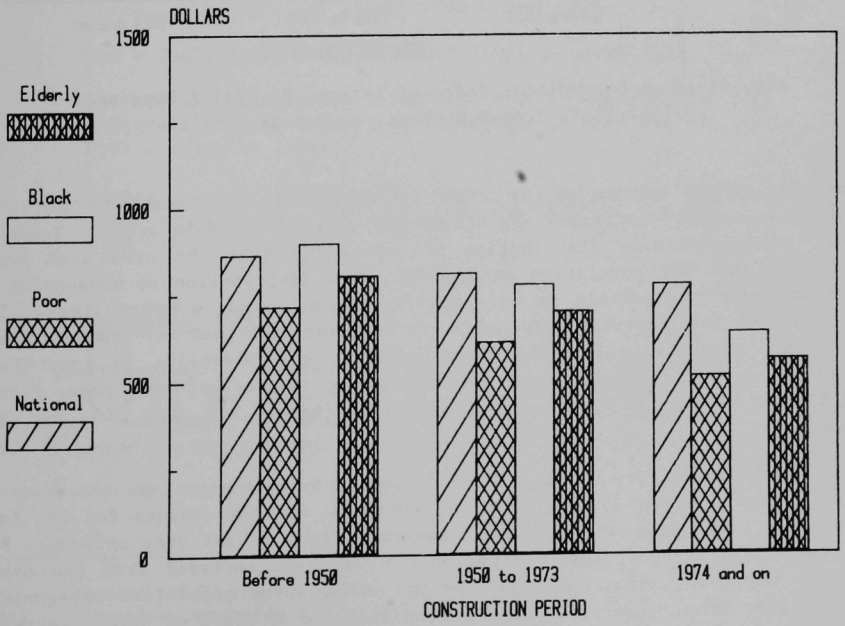

Fig. 15 Fuel Expenditure per Household, by Age of Housing for 1979 (Data from U.S. Dept. of Energy, 1981c)

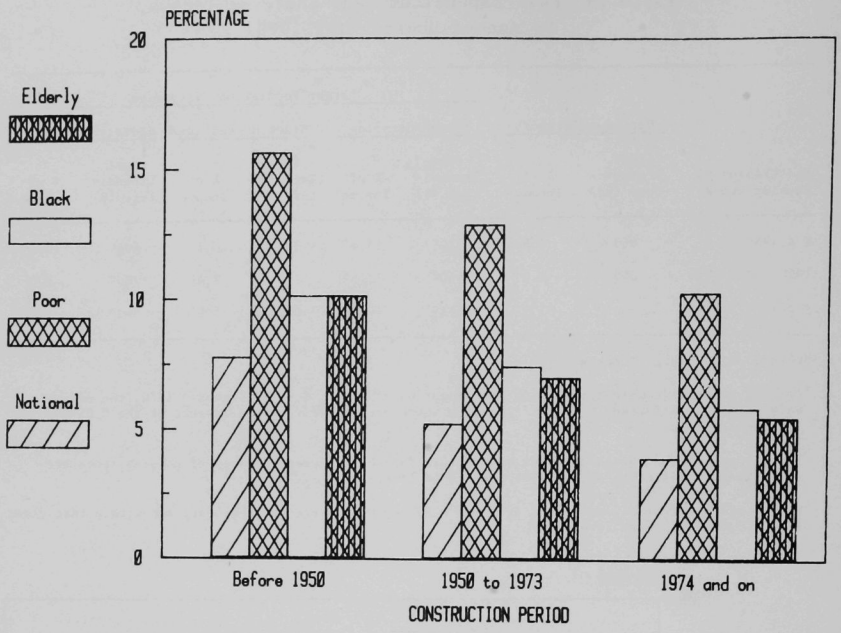

Fig. 16 Fuel Expenditure Share of Income, by Age of Housing for 1979 (Data from U.S. Dept. of Energy, 1981c)

four population categories by type of community. Consumption for each household category increases for households located in urban areas. Table 27 shows the approximate distribution of households over the urban and rural areas for the four population categories. The distribution of households in Poor and Black households is more heavily concentrated in urban areas. The distribution of Elderly households is similar to that of the National category. Overall, the overwhelming majority of households is located in urban areas. The percentage of all households in the National, Poor, Black, and Elderly categories in urban areas is approximately 73%, 84%, 90%, and 69%, respectively.

Fuel expenditure and its share of income by community type are shown in Table 28 and Figures 25 and 26. The movement of these values for the four population categories over the two community types is not very uniform. For example, fuel expenditures for National households increase from the urban area to the rural area, whereas for the other three population categories, expenditures drop. Likewise, fuel expenditures as a share of income increase in the rural areas for all but Poor households.

Table 20 Average Fuel Consumption, by Weather Zone for 1979 (10^6 Btu/Household)

Weather Zone[a]	National Category[b]	Target Population Categories: Poor Households	Black Households	Elderly Households
Cold CDD < 2000 HDD ≥ 5500	157	139[c]	233[c]	157
Mild CDD < 2000 HDD < 5500	119	105[c]	134[c]	111[c]
Hot CDD > 2000 HDD < 3999	89	79[c]	92	82[c]

Source: U.S. Dept. of Energy (1981c).

[a]CDD = Cooling degree days; HDD = Heating degree days.

[b]For all pairwise combinations, the mean values for the different weather zones are significantly different at the 0.05 confidence level.

[c]Values are significantly different from the mean value of their complementary set within that weather zone at the 0.05 confidence level.

4.2.6 Possessorship Type

Possessorship is divided into two types: owners and renters. In Table 29 and Figure 27, fuel consumption by possessorship class is shown. In all cases fuel consumption per household is lower for renters than for owners.* Table 30 shows the distribution of households between the two types of posses-

*These values, taken simply on their face value, may be somewhat deceiving. Fuel consumption, assuming all other things equal (including size of dwelling unit), may actually increase with a household that rents. The average level of consumption reflects the fact that specific types of living quarters are typically rented. These are in turn generally smaller and require less fuel.

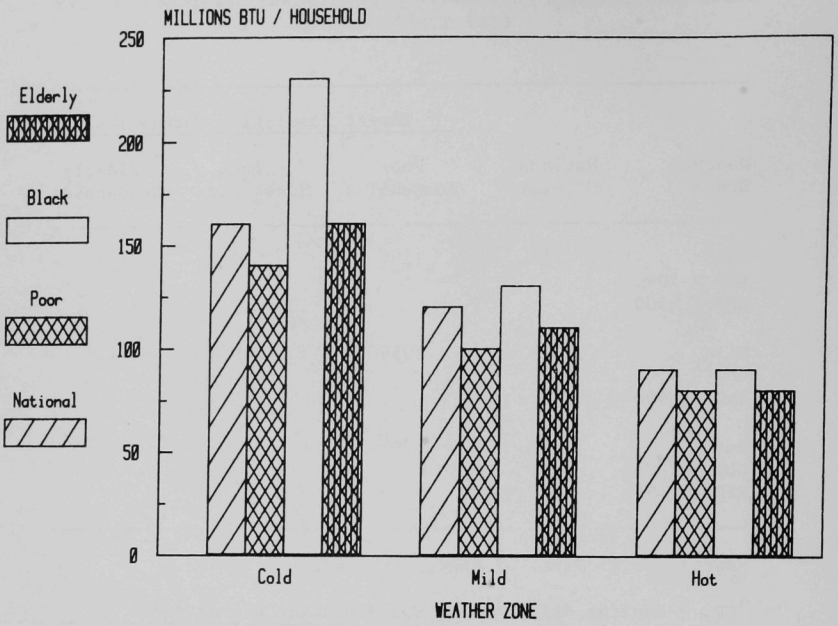

Fig. 17 Fuel Consumption per Household, by Weather Zone for 1979 (Data from U.S. Dept. of Energy, 1981c)

sorship. Compared to the National category, Poor and Black households tend to own fewer homes (52% and 57%, respectively, vs. 69% for National). Elderly, however, tend to own more (82%).

In all four population categories, renters spend less on fuel than owners. Annual expenditures range from approximately $570 for Elderly households to $700 for Black households, whereas in the owner class they range from approximately $700 for Poor households to $960 for Black households (see Table 31 and Figure 28). Because of income differences, however, expenditure's share of income is greater for all renting households except those in the Poor category.* For owner households, fuel expenditure share of income ranges from approximately 5.8% for National households to 14.7% for Poor households, whereas in the renter class it ranges from approximately 7.0% for National households to 13.9% for Poor households (see Table 31 and Figure 29).

*Since this category is defined using income as a criterion, the variance in income, as would be expected, is not large.

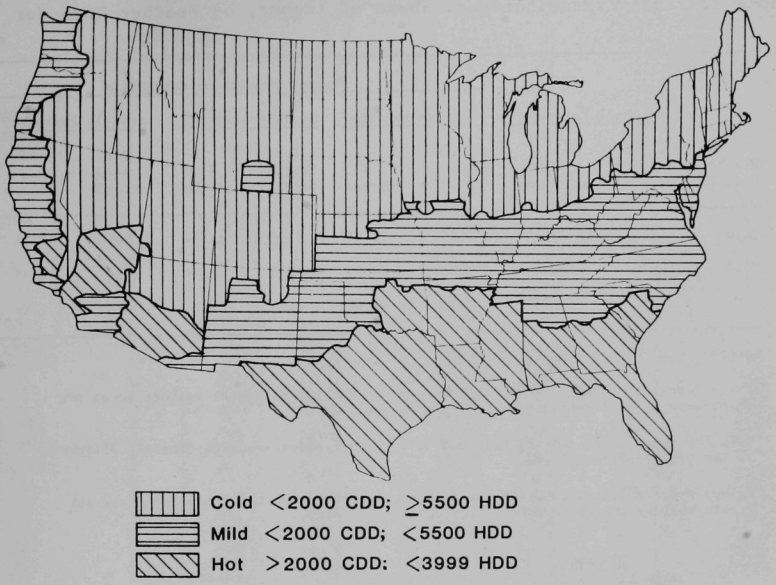

Fig. 18 Weather Zones of the U.S., Determined by Cooling Degree Days (CDD) and Heating Degree Days (HDD)

Table 21 Distribution of Households by Weather Zone, 1979 (%)

		Target Population Categories		
Weather Zone	National Category	Poor Households	Black Households	Elderly Households
Cold	36	30	17	32
Mild	51	51	53	52
Hot	14	19	30	16

Source: U.S. Dept. of Energy (1981c).

Table 22 Fuel Expenditure and Share of Income, by Weather Zone for 1979

	National Category		Target Population Categories					
			Poor Households		Black Households		Elderly Households	
Weather Zone	Fuel Expenditure ($)[a]	% of Income[b]	Fuel Expenditure ($)	% of Income	Fuel Expenditure ($)	% of Income	Fuel Expenditure ($)	% of Income
Cold	904	6.5	750[c]	16.6[c]	1198	12.7[c]	865[c]	9.7[c]
Mild	800	6.0	661[c]	13.9[c]	852	8.3[c]	720[c]	8.2[c]
Hot	733	6.3	549[c]	11.6[c]	635	8.0	633[c]	7.8[c]

Source: U.S. Dept. of Energy (1981c).

[a]For all pairwise combinations, the mean values for the different weather zones are significantly different at the 0.05 confidence level.

[b]Only the mean values for the Cold and Mild weather zones are significantly different at the 0.05 confidence level.

[c]Values are significantly different from the mean value of their complementary set within that weather zone at the 0.05 confidence level.

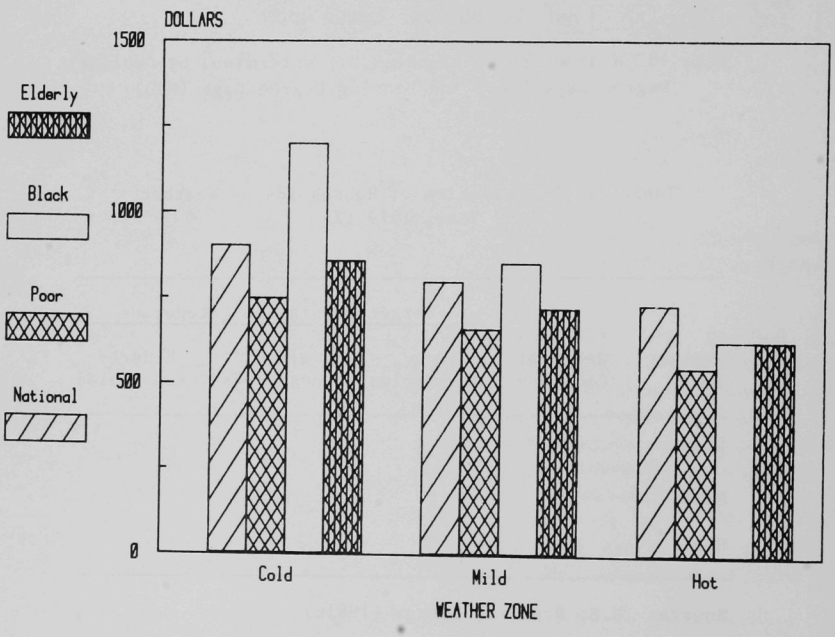

Fig. 19 Fuel Expenditure per Household, by Weather Zone for 1979 (Data from U.S. Dept. of Energy, 1981c)

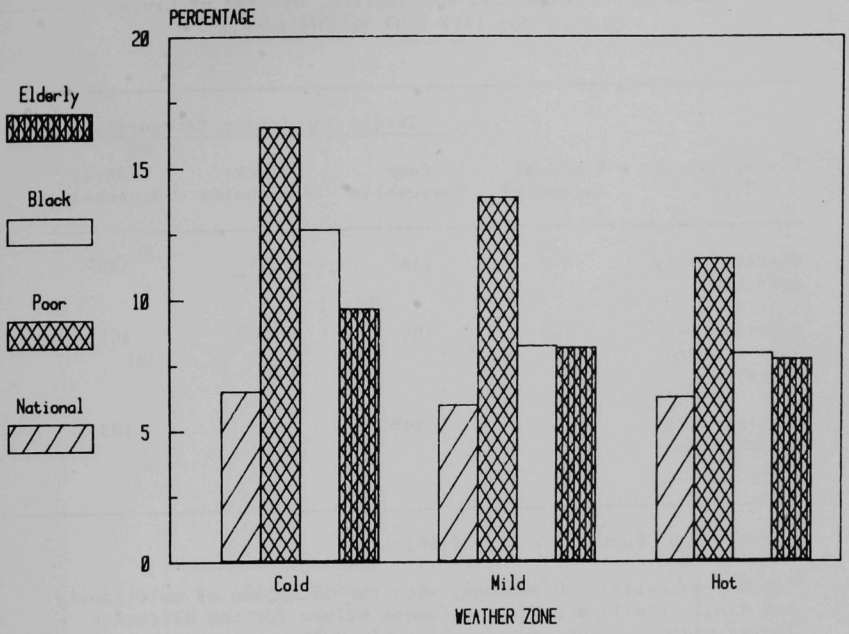

Fig. 20 Fuel Expenditure Share of Income, by Weather Zone for 1979 (Data from U.S. Dept. of Energy, 1981c)

4.2.7 Primary Heating Fuel

The average level of fuel consumption per household for the four population categories by the primary fuel source for space heating is given in Table 32 and Figure 30. The average fuel consumption per household is highest for those households using either piped natural gas or fuel oil/kerosene as the primary fuel source for space heating. The distribution of households by primary fuel for space heating is given in Table 33 for all four population categories. Natural gas is the most commonly used fuel; of the National, Poor, Black, and Elderly households, approximately 55%, 58%, 65%, and 55%, respectively, use natural gas as the primary fuel for space heating.

Table 34 and Figures 31 and 32 show fuel expenditures and their share of income. The values vary widely, with highest in households that use fuel oil/kerosene as the primary fuel for space heating. Annual fuel expenditures for these households range from approximately $1000 for Poor households to $1300 for Black households. Share of income ranges from approximately 8.9%

Table 23 Average Fuel Consumption, by Type of Living Quarter for 1979 (10^6 Btu/Household)

Living Quarter Type	National Category[a]	Target Population Categories		
		Poor Households	Black Households	Elderly Households
Single-family detached	139	118[b]	145	128[b]
Multifamily (two or more units)	106	104	129[b]	101
Single-family attached and other	107	87[b]	123	103

Source: U.S. Dept. of Energy (1981c).

[a]For all pairwise combinations, with the exception of multifamily and single-family attached, the mean values for the different living quarter types are significantly different at 0.05 confidence levels.

[b]Values are significantly different from the mean value of their complementary set within that living quarter type at the 0.05 confidence level.

for National households to 20.9% for Poor households. On the other hand, natural gas expenditures range only from about $610 for Poor households to $750 for National households, and share of income for the same two categories is about 13.5% and 5.8%, respectively.

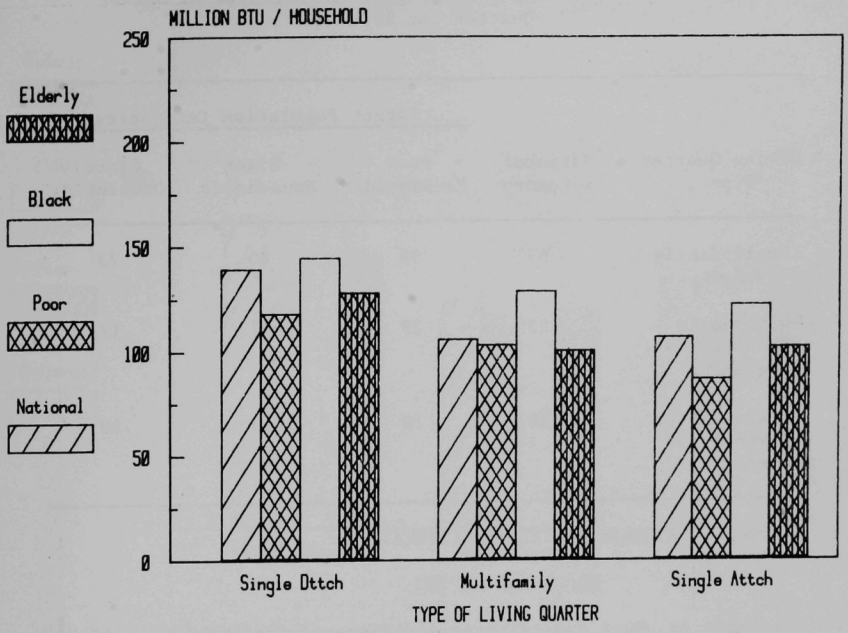

Fig. 21 Fuel Consumption per Household, by Type of Living Quarter for 1979 (Data from U.S. Dept. of Energy, 1981c)

Table 24 Distribution of Households, by Type of Living Quarter for 1979 (%)

Living Quarter Type	National Category	Target Population Categories: Poor Households	Black Households	Elderly Households
Single-family detached	67	59	60	73
Multifamily (two or more units	23	29	27	17
Single-family attached and other	10	12	13	10

Source: U.S. Dept. of Energy (1981c).

Table 25 Fuel Expenditures and Share of Income by Type of Living Quarter, 1979

Living Quarter Type	National Category		Target Population Categories: Poor Households		Black Households		Elderly Households	
	Fuel Expenditure ($)[a]	% of Income[b]	Fuel Expenditure ($)	% of Income	Fuel Expenditure ($)	% of Income	Fuel Expenditure ($)	% of Income
Single-family detached	898	6.1	703[c]	14.7[c]	874	8.5[c]	796[c]	8.8[c]
Multifamily (two or more units)	670	6.6	621	14.3[c]	814[c]	10.2[c]	640	9.1[c]
Single-family attached and other	713	6.2	591[c]	12.2[c]	763	8.2[c]	632[c]	7.2[c]

Source: U.S. Dept. of Energy (1981c).

[a]For all pairwise combinations, with the exception of multifamily and single-family attached, the mean values for the different living quarter types are significantly different at the 0.05 confidence level.

[b]Only for the single-family detached and the multifamily is the mean value of fuel expenditure share significantly different at the 0.05 confidence level.

[c]Values are significantly different from the mean value of their complementary set within that living quarter types at the 0.05 confidence level.

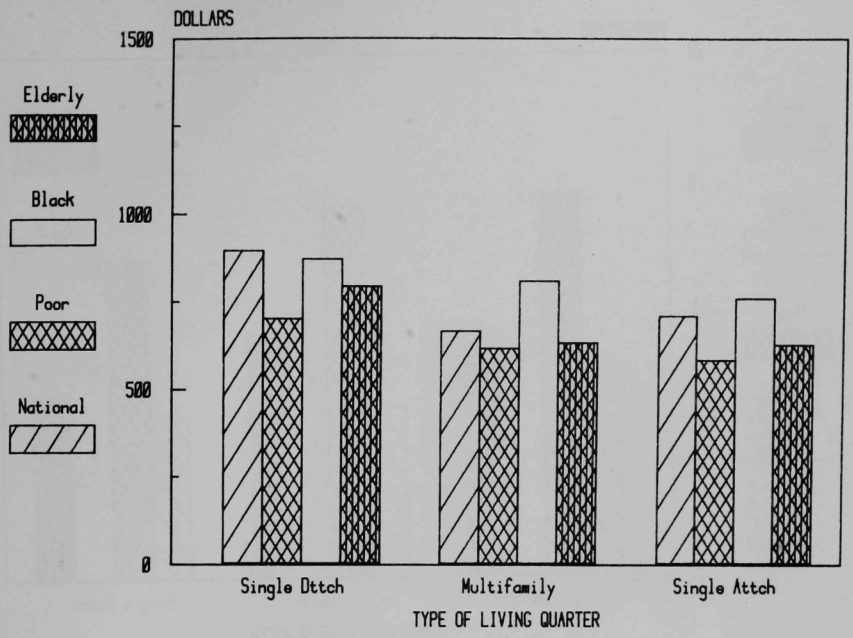

Fig. 22 Fuel Expenditure per Household, by Type of Living Quarter for 1979 (Data from U.S. Dept. of Energy, 1981c)

Table 26 Average Fuel Consumption, by Community Type for 1979 (10^6 Btu/Household)

		Target Population Categories		
Type	National Category[a]	Poor Households	Black Households	Elderly Households
Urban	134	116[b]	141	128[b]
Rural	115	96[b]	113	105[b]

Source: U.S. Dept. of Energy (1981c).

[a]Mean values for urban and rural areas are significantly different at the 0.05 confidence level.

[b]Values are significantly different from the mean value of their complementary set within that community at the 0.05 confidence level.

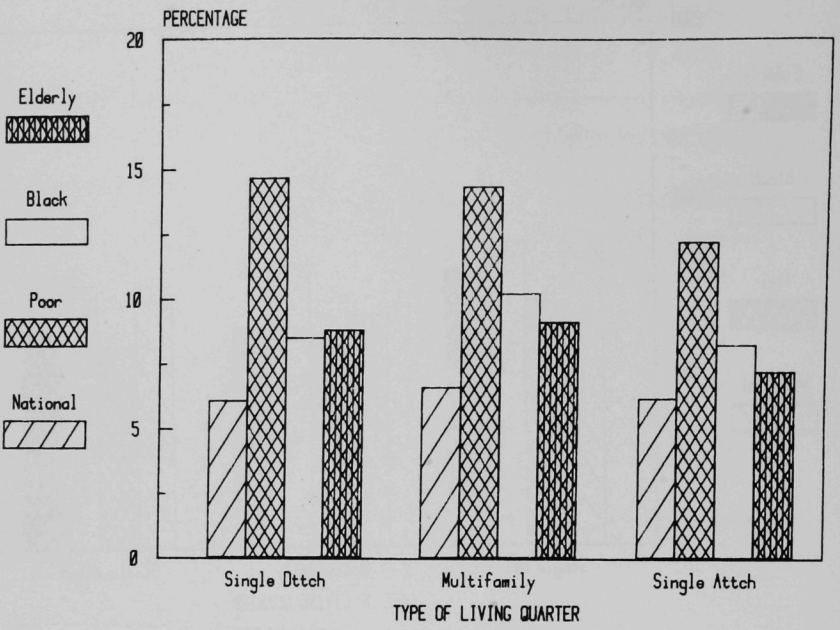

Fig. 23 Fuel Expenditure Share of Income, by Type of Living Quarter for 1979 (Data from U.S. Dept. of Energy, 1981c)

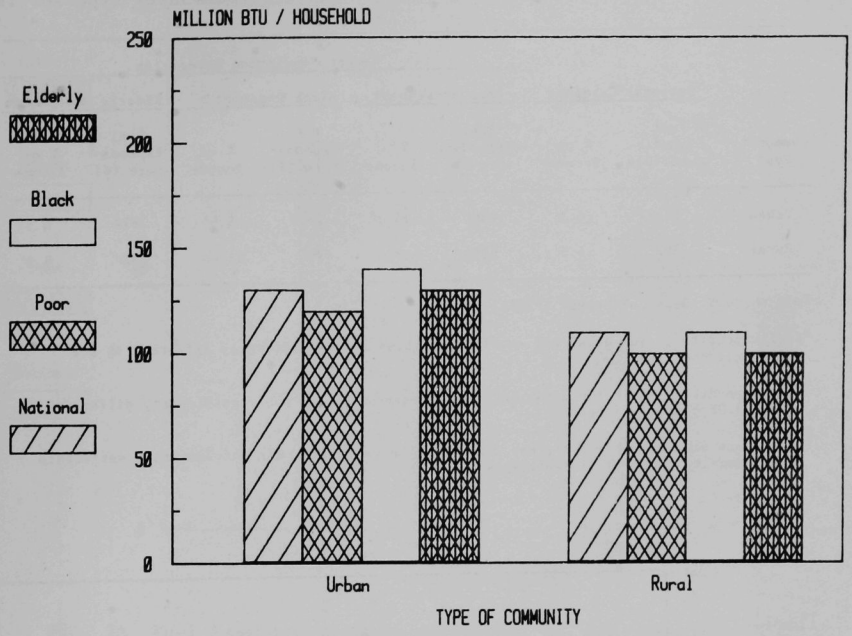

Fig. 24 Fuel Consumption per Household, by Community Type for 1979 (Data from U.S. Dept. of Energy, 1981c)

Table 27 Distribution of Households, by Community Type for 1979 (%)

		Target Population Categories		
Type	National Category	Poor Households	Black Households	Elderly Households
Urban	73	84	90	69
Rural	27	16	10	31

Source: U.S. Dept. of Energy (1981c).

Table 28 Fuel Expenditure and Share of Income, by Community Type for 1979

Community Type	National Category		Target Population Categories					
			Poor Households		Black Households		Elderly Households	
	Fuel Expenditure ($)[a]	% of Income[b]	Fuel Expenditure ($)	% of Income	Fuel Expenditure ($)	% of Income	Fuel Expenditure ($)	% of Income
Urban	816	6.1	686[c]	14.7[c]	855	8.6[c]	767[c]	8.5[c]
Rural	862	6.5	618[c]	13.4[c]	754	11.4[c]	722[c]	8.9[c]

Source: U.S. Dept. of Energy (1981c).

[a]Fuel expenditures for urban and rural communities are significantly different at the 0.05 confidence level.

[b]Fuel expenditure share for urban and rural communities are not significantly different at the 0.05 confidence level.

[c]Values are significantly different from the mean value of their complementary set within that community at the 0.05 confidence level.

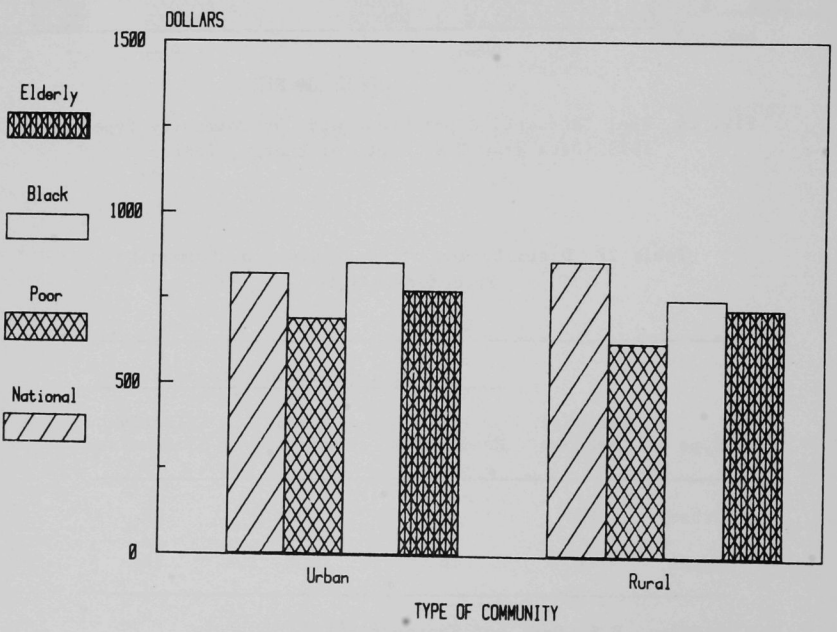

Fig. 25 Fuel Expenditure per Household, by Community Type for 1979 (Data from U.S. Dept. of Energy, 1981c)

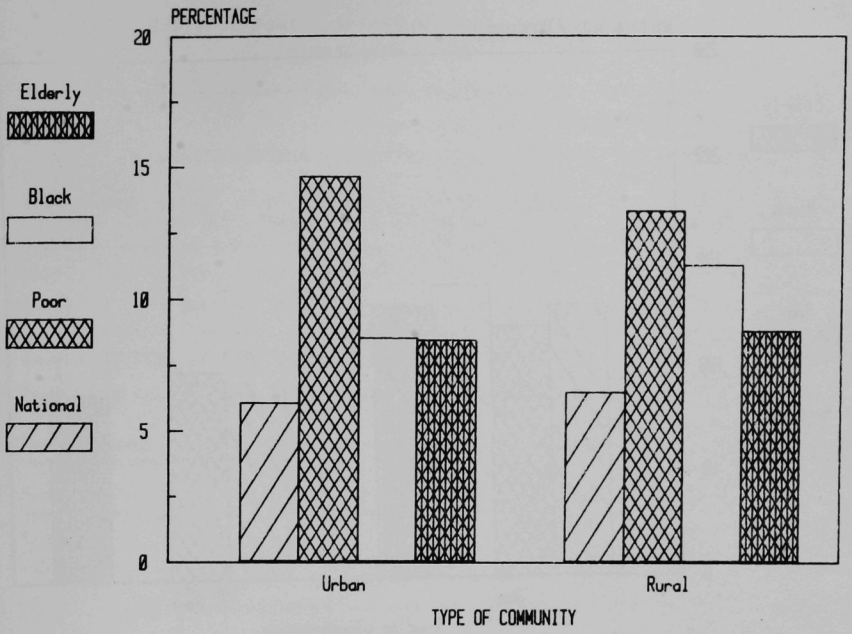

Fig. 26 Fuel Expenditure Share of Income, by Community Type for 1979 (Data from U.S. Dept. of Energy, 1981c)

Table 29 Average Fuel Consumption, by Possessorship Type for 1979 (10^6 Btu/Household)

Possessorship Type	National Category[a]	Target Population Categories: Poor Households	Black Households	Elderly Households
Owner	134	116[b]	156[b]	128[b]
Renter	106	104	114	87[b]

Source: U.S. Dept. of Energy (1981).

[a]Mean values for owner and renter classes are significantly different at the 0.05 confidence level.

[b]Values are significantly different from the mean value of their complementary set within that possessorship class at the 0.05 confidence level.

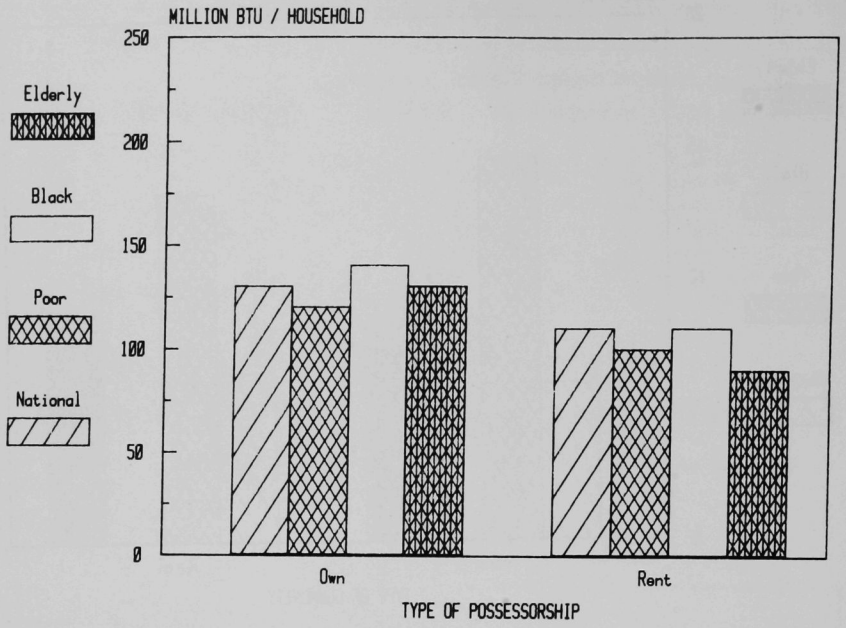

Fig. 27 Fuel Consumption per Household, by Possessorship Type for 1979 (Data from U.S. Dept. of Energy, 1981c)

Table 30 Distribution of Households, by Possessorship Type for 1979 (%)

Possessorship Type	National Category	Target Population Categories		
		Poor Households	Black Households	Elderly Households
Owner	69	52	57	82
Renter	31	48	43	18

[a]U.S. Department of Energy (1981c).

Table 31 Fuel Expenditure and Share of Income, by Possessorship Type for 1979

Possessorship Type	National Category		Target Population Categories					
			Poor Households		Black Households		Elderly Households	
	Fuel Expenditure ($)[a]	% of Income[b]	Fuel Expenditure ($)	% of Income	Fuel Expenditure ($)	% of Income	Fuel Expenditure ($)	% of Income
Owner	899	5.8	699[c]	14.7[c]	957	8.1[c]	793[c]	8.5[c]
Renter	669	7.0	630[c]	13.9[c]	695	9.9[c]	572[c]	9.4[c]

Source: U.S. Dept. of Energy (1981c).

[a]Fuel expenditures for owner and renters are significantly different at the 0.05 confidence level.

[b]Fuel expenditures share for owner and renters are significantly different at the 0.05 confidence level.

[c]Values are significantly different from the mean value of their complementary set within that possessorship type at the 0.05 confidence level.

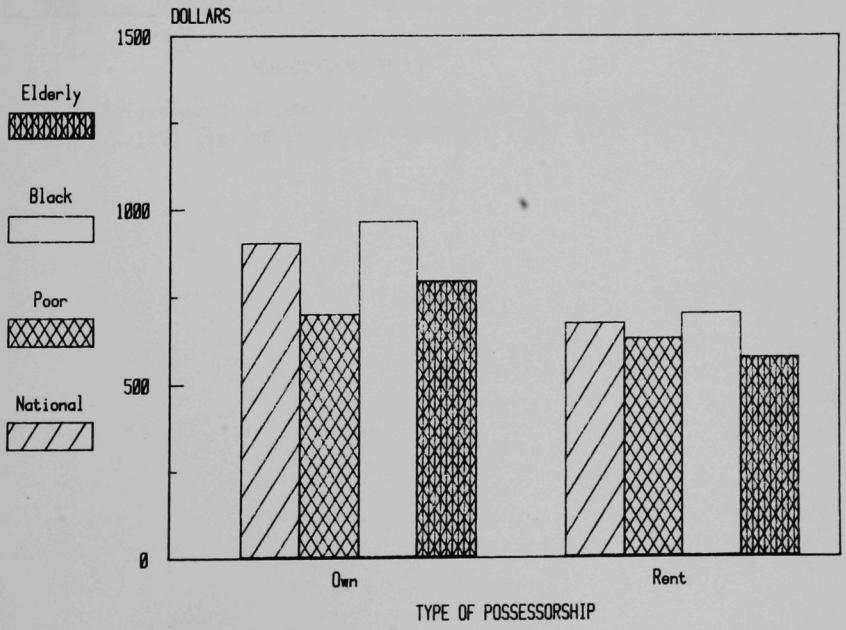

Fig. 28 Fuel Expenditure per Household, by Possessorship Type for 1979 (Data from U.S. Dept. of Energy, 1981c)

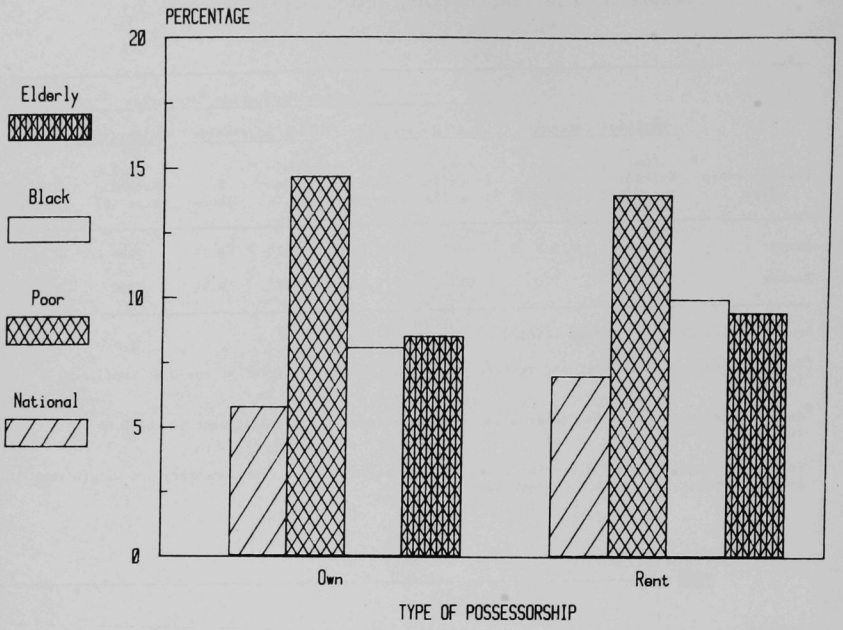

Fig. 29 Fuel Expenditure Share of Income, by Possessorship Type for 1979 (Data from U.S. Dept. of Energy, 1981c)

Table 32 Average Fuel Consumption, by Primary Fuel Used for Space Heating, 1979 (10^6 Btu/Households)

Primary Fuel	National Category[a]	Target Population Categories: Poor Households	Black Households	Elderly Households
Natural gas	145	125[c]	146	136[c]
LPG	105	71[c]	77[c]	81[c]
Fuel oil/ kerosene	150	126[c]	157	145
Electricity	72	68	71	65[c]

Source: U.S. Department of Energy (1981c).

[a]All pairwise combinations, with the exception of natural gas and fuel oil, are significantly different at the 0.05 confidence level.

[b]Values are significantly different from the mean value of their complementary set within that primary fuel class at the 0.05 confidence level.

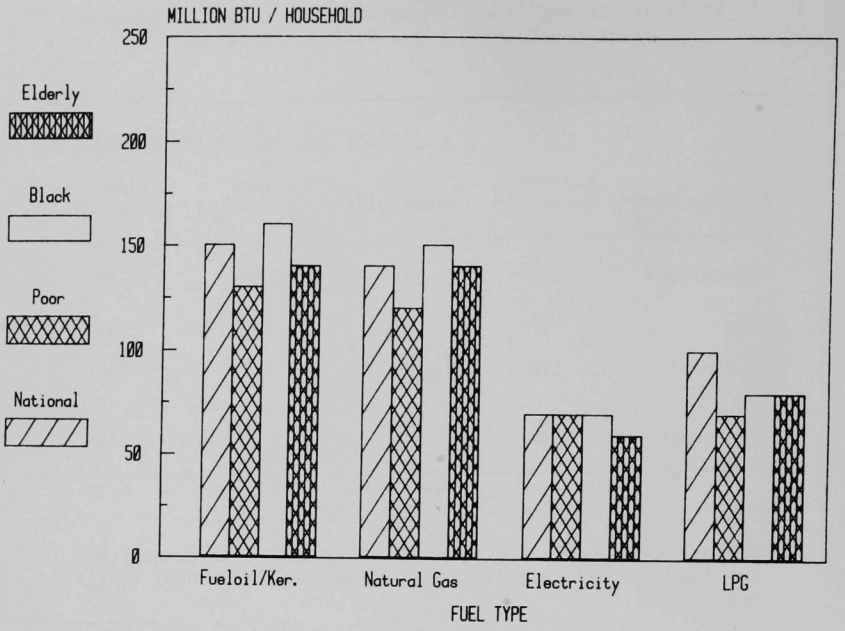

Fig. 30 Fuel Consumption per Household, by Primary Fuel Used for Space Heating, 1979 (Data from U.S. Dept. of Energy, 1981c)

Table 33 Distribution of Households, by Primary Fuel Used for Space Heating, 1979 (%)

Primary Fuel	National Category	Target Population Categories: Poor Households	Black Households	Elderly Households
Natural gas	55	58	65	55
LPG	5	7	5	5
Fuel oil/ kerosene	19	18	22	22
Electricity	16	12	6	14
Other	5	6	2	5

Source: U.S. Department of Energy (1981c).

Table 34 Fuel Expenditure and Share of Income, by Primary Fuel Used for Space Heating, 1979

Primary Fuel	National Category		Target Population Categories: Poor Households		Black Households		Elderly Households	
	Fuel Expenditure ($)[a]	% of Income	Fuel Expenditure ($)	% of Income	Fuel Expenditure ($)	% of Income	Fuel Expenditure ($)	% of Income
Natural gas	752	5.8	614[b]	13.5[b]	737	7.5[b]	672[b]	8.1[b]
LPG	900	7.4	625[b]	13.6[b]	630[b]	11.3[b]	664[b]	9.6[b]
Fuel oil/ kerosene	1213	8.9	1027[b]	21.6[b]	1290	13.2[b]	1140[b]	11.9[b]
Electricity	685	4.6	549[b]	11.7[b]	764	7.2[b]	592[b]	6.6[b]

Source: U.S. Dept. of Energy (1981c).

[a]All pairwise combinations are significantly different at the 0.05 confidence level.

[b]Values are significantly different from the mean value of their complementary set within that primary fuel source class at the 0.05 confidence level.

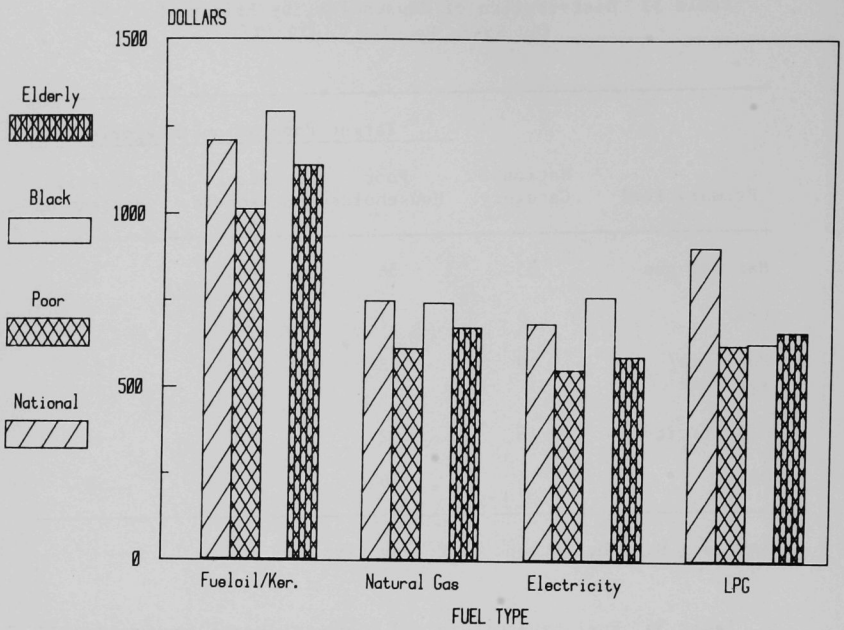

Fig. 31 Fuel Expenditure per Household, by Primary Fuel Used for Space Heating, 1979 (Data from U.S. Dept. of Energy, 1981c)

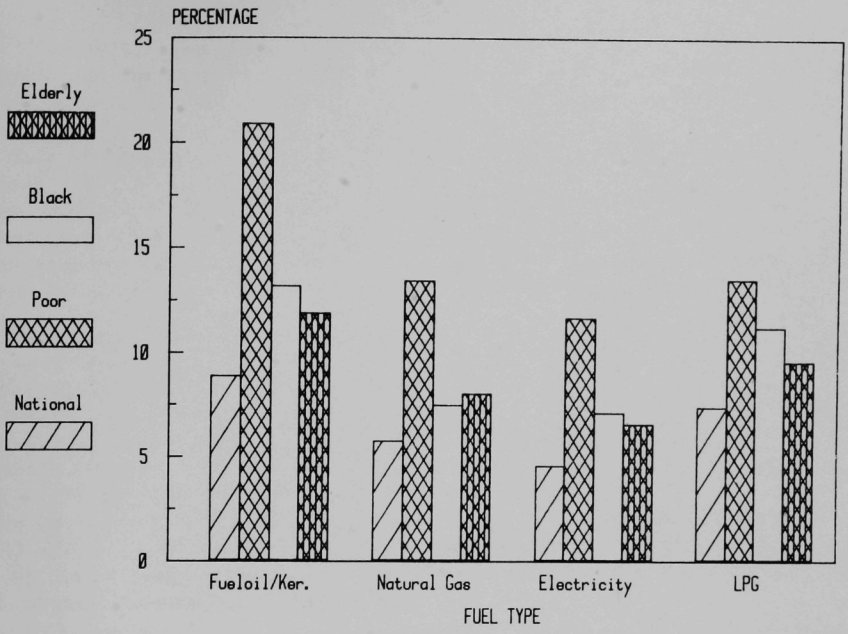

Fig. 32 Fuel Expenditure Share of Income, by Primary Fuel Used for Space Heating, 1979 (Data from U.S. Dept. of Energy, 1981c)

5 SUMMARY

In 1979, there were significant variations in the level of fuel consumption and the relative fuel expenditure share of family income between the target population categories and the National category. Fuel expenditure share also varied dramatically across census regions as a result of the level of fuel consumption, types of fuel consumed, and differing income. In general, fuel consumption was lower for the target population categories; the Black population category, however, was an exception. Moreover, the fuel expenditure share of family income was generally higher for the target population categories. Table 35 summarizes fuel consumption and its share of family income across census regions for the population categories.

In 1979, the fuel expenditure share of family income of Poor households was more than twice the U.S. average -- 14.3% vs. 6.2%. The average Poor household in 1979 consumed 110 x 10^6 Btu of energy, whereas the average U.S. household consumed 127 x 10^6 Btu of energy. In the Northeast and North Central regions, annual fuel consumption increases dramatically for Poor and National households -- 136 and 145 x 10^6 Btu for Poor households and 150 and 166 x 10^6 Btu for the National household. Moreover, the fuel expenditure share gap increases in these two regions. In the Northeast region, they are 19.1% and 7.7% for the Poor household and National household, respectively. In the North Central region, they are 15.2% and 6.3% for the Poor household and National household, respectively.

For Black households, there is an unusual pattern of fuel consumption. Contrary to what would be expected on basis of the income effect alone, the average annual level of energy consumption by Black households was higher than the U.S. average -- 138 x 10^6 Btu/household vs. 127 x 10^6 Btu/household. The average fuel expenditure share of family income is also higher -- 8.9% vs. 6.2%. In 1979, the gap in energy consumption in the Northeast and North Central regions was much wider. In the Northeast, average fuel consumption was 184 x 10^6 Btu/household and 150 x 10^6 Btu/household for Black and National households, respectively. This amounts to an approximate 20% difference. In the North Central region, average household fuel consumption was 217 x 10^6 Btu and 166 x 10^6 Btu for Black and National households, respectively. This amounts to an approximate 30% difference. The fuel expenditure share of income for Black households in these two regions increased to 13.4% in the Northeast region and 9.5% in the North Central region. Preliminary evidence indicates that housing age plays an important role here.*

In 1979, Elderly households consumed slightly less energy than the U.S. average; 121 x 10^6 Btu/household vs. 127 x 10^6 Btu/household. The average

*Analysis also suggests that family size is important. The actual impact will be reported in Volume 2.

Table 35 Fuel Consumption and Share of Family Income, by Region for 1979

	National Category		Target Population Categories					
			Poor Households		Black Households		Elderly Households	
Census Region	Fuel Consumption[a] (10^6 Btu/ Household)	% of Income[b]	Fuel Consumption (10^6 Btu/ Household	% of Income	Fuel Consumption (10^6 Btu/ Household	% of Income	Fuel Consumption (10^6 Btu/ Household	% of Income
Northeast	150	7.7	136[c]	19.1[c]	184[c]	13.4[c]	157	11.7[c]
North Central	166	6.3	145[c]	15.2[c]	217[c]	9.5[c]	157[c]	8.9[c]
South	95	6.3	83[c]	12.8[c]	102[c]	8.5[c]	86[c]	8.3[c]
West	100	3.9	83[c]	9.8[c]	85	3.8	86[c]	5.2[c]
U.S. Average	127	6.2	110[c]	14.3[c]	138[c]	8.9[c]	121[c]	8.6[c]

Source: U.S. Dept. of Energy (1981c).

[a]For all pairwise combinations the mean values for census regions for the National category are not significantly equal at 0.05 confidence level.

[b]For all pairwise combinations, with the exception of North Central and South regions, the mean values for census regions are not significantly equal at 0.05 confidence level.

[c]Values are significantly different than the mean value of their complementary set at 0.05 confidence level.

fuel expenditure share of income was higher: 8.6% vs. 6.2%. In the Northeast region, energy consumption and the fuel expenditure share gap increase dramatically, with the former increasing to 157 x 10^6 Btu/household and the latter increasing to 11.7%.

The importance of fuel, as measured by its expenditure share of income, is substantially higher for the three target categories. Average fuel consumption per household for the three target categories is significantly different from nontarget categories. However, the magnitude in its relationship differs with population category. For example, both Poor and Elderly households consume significantly less fuel than do non-Poor and non-Elderly households, while Black households consume significantly more than do non-Black households.

Fuel use patterns for the target categories vary somewhat in magnitude but little in relative terms. In general, consumption of important space-heating fuels (i.e., natural gas and fuel oil/kerosene) is insignificantly different for all population categories when compared with their complements, except for Poor households. Consumption of electricity (a secondary fuel) is, however, significantly different between the categories and their complements. The consumption of electricity is positively influenced by income. Since on the average, the three target categories have incomes significantly lower than their complement, their consumption of electricity is lower.

The relative magnitude of fuel consumption patterns and fuel expenditure shares provides the most important policy implication. A higher fuel expenditure share of family income indicates greater importance of fuel for that family. Furthermore, share of income gives an indirect indication of the degree to which fuel price changes influence family well-being. Those who pay a higher proportion of their income for fuel can be expected to suffer disproportionately more with an increase in the cost of fuel. Therefore, since the fuel expenditure shares for the three target household categories considered in this report are higher than their complements, increases in fuel price can be expected to disporportionately affect, in an adverse way, the general standard of living of these households.

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